MUNICIPALITY OF EAST HANTS

TRANSIT SERVICES 2024 UPDATE

DRAFT FINAL REPORT

December 5, 2024

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DRAFT FINAL REPORT

PROJECT NO.: CA0033180.2615

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EXECUTIVE SUMMARY

BACKGROUND

The ***Transit Services 2024 Update*** provides additional and updated information to a series of previous reports examining the feasibility and business case for operating fixed route transit service in East Hants. Studies include:

- ***Corridor Feasibility Study*** **(2012)**
- ***Transit Services Business Plan for East Hants*** **(2015)**
- ***Transit Services Business Plan 2020 Update*** **(2020)**

More recently, the Municipality's 2021-2024 Strategic Plan has identified the strategic focus of Economic Prosperity. One of the objectives under that theme is to "invest in transit that supports our community's workforce, accessibility, and environmental stewardship." With this renewed focus, the Municipality is examining bringing the concept of fixed route transit to a position where Council can make a decision regarding implementation.

Each of the previous studies considered fixed route public transit along the Trunk 2 and Route 214 serving destinations in Lantz, Elmsdale, Enfield and the Halifax Stanfield Airport (see Appendix A, Map 1). Routing now proposed is portrayed in Figure A and Appendix A, Map 2.

Figure A: Proposed 2024 Routing

CHANGES SINCE THE 2020 STUDY

Although the ***Transit Services 2024 Update*** essentially builds on the 2020 Update, it recognizes that some key changes in the roadway network, growth patterns, and vehicle technology have occurred in the intermediate years. Those changes have resulted in reconsideration of some of the discussion and recommendations. They are summarized in Table A.

Aspect of 2020 Study	Change in 2024 Study
Routing	The 2024 proposed routing (see Appendix A) abandons a loop through the Logan Drive subdivision and replaces it with a loop through a planned development (Clayton Lands) south of the Lantz Connector. This change is warranted due to the much higher density proposed for the developing lands.
Buses	In 2020, battery-electric buses (BEB) were an emerging technology and not widely available. Today, they are in more common use (including Halifax Regional Municipality) and can attract funding that supports green technologies. The 2024 study examines BEB as a viable option (see Section 4) by assessing four operating scenarios involving different types of buses.
Partnership Model	The 2020 study recommended that an agreement be reached with EHCR whereby both parties share in the responsibilities of operating the service. A review by the Municipality's insurer determined that a model with shared responsibility would be problematic. The 2024 study considers two scenarios where each party is a potential operator of the service with full responsibility.
Provincial Involvement	In 2021, the Joint Regional Transportation Agency (JRTA) was created by the Province to guide the collaborative development and implementation of a Regional Transportation Plan for the Halifax Regional Municipality and surrounding communities. It is expected that the Plan will recommend a regional transit service along the Highway 102 corridor that provides an opportunity to link with the East Hants service.

Table A: Changes from the 2020 Study

FEASIBILITY OF BATTERY ELECTRIC BUSES

For the East Hants service, a diesel bus can have its tank filled at the beginning of the day and do a full day of service without requiring a refill of the tank. The battery on a standard battery-electric bus (BEB), however, has insufficient capacity to complete the full-service day defined for the East Hants service. Successful operation will require either topping up the battery in-route at dwelling intervals or swapping in a second bus while the first bus recharges at the depot.

After examining a series of operating scenarios, it was determined that two transit-style BEB's could complete a full day of service with a swapping strategy but two shuttle-style BEB's (with their reduced range) could not. The two transit-style BEB's, in fact, would provide sufficient capacity to consider operating both buses together for a few hours through the two commuter peak periods. The option of operating a single bus with in-route charging was ultimately removed from consideration due to the high cost of charging infrastructure and the limited dwelling time available in the routing plan.

OPERATING PLAN STRATEGIES

To conduct a financial assessment, four operating strategies were developed from combinations of the alternatives of BEB's versus diesel buses and hourly service all day (referred to as Phase One) versus increasing frequency to thirty minutes during commuter peaks (referred to as Phase 2).

During the course of the study, it was decided that the bus depot would be located at the East Hants Sportsplex and that buses would be 35-foot transit-style buses. Although more expensive to purchase, transit-style buses have a longer service life, have greater battery range, and are more comfortable than shuttle-style buses.

The life cycle fleet cost of the four strategies over twelve years is provided in Figure C. The costs given for the phase two strategies are the total costs including phase one.

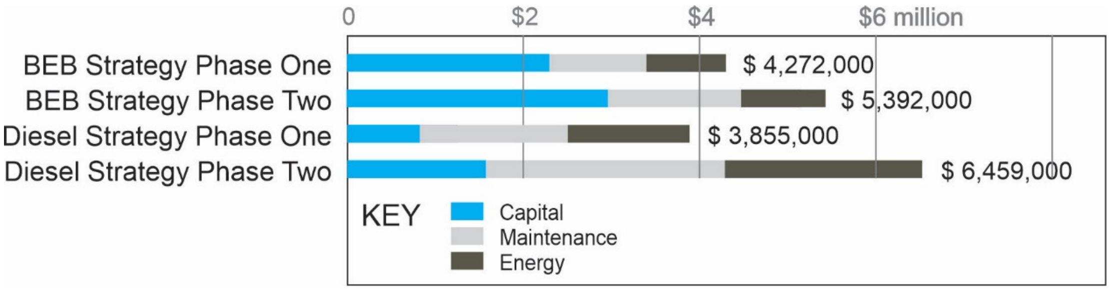

Figure B: 12-Year Life Cycle Cost of Operating Strategies

From this assessment, the BEB Strategy was recommended with implementation of Phase One service initially. Although this strategy is slightly more expensive that the corresponding Diesel Strategy, the BEB Strategy is more affordable in the long term, assuming Phase Two service will be required in the future.

Figure B provides a graphical representation of the recommended BEB Phase One Strategy. The diagram shows how the total charge diminishes through the morning until the bus must be pulled from service for a recharge. For a short period mid-day (projected to be three hours in duration), while the BEB recharges at the depot, a diesel bus is put into service. Once the BEB is fully charged it is returned to service to complete the day. The diesel bus can act as a spare when the BEB requires servicing and may be purchased either new or used.

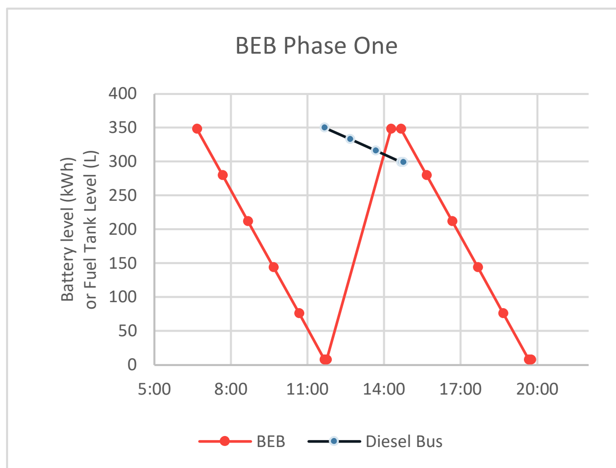

Figure C: Battery Level for BEB

ASPECTS OF OPERATION

The study explored a number of aspects of operation that the operator of the service (whether the Municipality or EHCR) will need to deal with. They are summarized in Table B.

Aspect of Operation	How the 2024 Study Addresses It
Staffing	The operator is expected to require six-tenths of an FTE (full-time equivalent) to administer the operation of the service and one-tenth of an FTE for senior level management.
Fleet	The fleet requirement for the recommended service strategy is one new BEB and one new or used diesel bus. If the Municipality were to operate the service, they would purchase both buses. If EHCR were to operate the service, the Municipality would provide funding to purchase the BEB and a new diesel bus. There is an opportunity that the "backup" diesel bus might be one of EHCR's existing buses or vans and could be used as needed and when available in the on-demand transit service.
Insurance	The operator, whether the Municipality or EHCR, would be responsible for insuring the assets and general liability associated with the service.
Vehicle Storage and Maintenance	Vehicles will be stored outside at the Sportsplex overnight. There are no vehicle repair shops locally that can lift a bus the size of the BEB specified for the service. The best opportunity for maintenance may be with an existing bus service such as Halifax Transit, Kings Transit or Coach Atlantic.
Driver Shifts	A strategy is provided for driver shifts. With Phase One service, there are two simple shifts with the day split nearly equally into two shifts. With Phase Two service, four drivers are required with a series of overlapping shifts.

Table B: Addressing Aspects of Operation

COST SUMMARY

The Study examined costs and projected revenue of the Phase One BEB Strategy. Those costs are summarized in Table C and assume 2024 dollars.

OPERATING COST	
Item	Cost (2024$)
Energy	$62,800
Maintenance	$28,600
Vehicle Repl. Reserve	$87,000
Driver Salaries	$125,400
Admin. Salaries	$94,100
Misc.	$28,000
TOTAL	$425,900

CAPITAL COST	
Item	Cost (2024$)
BEB Vehicle	$1,350,000
Diesel Vehicle	$740,000
Spare Vehicle Leasing	$20,000
Charging Infrastructure	$170,000
TOTAL	$2,280,000

ONE-TIME START-UP COST	
Item	Cost (2024$)
Bus Stops & Signs	$90,000
Engineering	$35,000
Marketing/Branding	$8,000
Vehicle Tracking App	$7,000
TOTAL	$140,000

REVENUE	
Item	Value (2024$)
Fare Revenue	$47,000

Table C: Cost Summary

RECOMMENDATIONS

The study recommends that the Municipality of East Hants move towards implementation of a one-hour fixed route transit service between Halifax Stanfield Airport and the East Hants Sportsplex. The service would be run using a new 35-foot battery-electric transit bus supported by a new or used diesel bus. For reference, a 35-foot transit bus is slightly smaller than the 40-foot buses that make up the bulk of the Halifax Transit fleet.

The study recommends that the Municipality of East Hants enter into a discussion with East Hants Community Rider with the objective of negotiating a contract for EHCR to operate a fixed route transit service on behalf of the Municipality. The study notes that this type of model is in operation elsewhere in Nova Scotia (Pictou

County and Antigonish County) and that EHCR appear capable of taking on this responsibility. The agreement would require the Municipality to provide funding to EHCR for the purchase of a new BEB and charging infrastructure. EHCR's first-year budget would be based on information provided in the study, but would be updated annually to reflect actual costs and revenues.

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1 INTRODUCTION

1.1 BACKGROUND

For the past several years, the notion of providing a fixed route transit service within the Lantz-to-Enfield corridor of East Hants has been studied and debated. The concept has struggled, however, to find its way to implementation amongst many competing needs for municipal investment. More recently, the Municipality's 2021-2024 Strategic Plan has identified the strategic focus of Economic Prosperity. One of the objectives under that theme is to "invest in transit that supports our community's workforce, accessibility, and environmental stewardship." With this renewed focus, the Municipality now wishes to bring the concept of fixed route transit to a position where Municipal Council can consider its implementation.

The concept of fixed route transit service in East Hants has been built on a progressive series of studies, each adding greater refinement to the concept, leading to the creation of a business plan. Those studies are:

- ***Corridor Feasibility Study*** **(2012)**
- ***Transit Services Business Plan for East Hants*** **(2015)**
- ***Transit Services Business Plan 2020 Update*** **(2020)**

There have been several changes since the 2020 Plan to warrant some additional study before moving toward implementation of transit service. Those changes, which include population distribution and growth, roadway network layout, emerging technologies in transit, and changing priorities in other levels of government, will be explored and described in this 2024 Update Study.

1.2 PROJECT OBJECTIVE

The objective of this study is to define a transit service and operating plan that meets the Strategic Plan objective of supporting the community's workforce, accessibility, and environmental stewardship with the goal of enhancing the economic prosperity of the Municipality. In meeting this objective, we will build on the work completed to date, paying careful attention to where recent changes have necessitated a pivot in the approach or where new opportunities have emerged.

The study will also explore the options of a service operated by the Municipality and a service operated by East Hants Community Rider (EHCR), the local not-for-profit agency that currently operates an on-demand transit service within East Hants. This assessment will help in determining which model makes the most sense for sustainable, long-term operation.

1.3 OVERVIEW OF THE 2020 STUDY

The ***East Hants Transit Service Operational and Business Plan*** was undertaken in 2020 by WSP to follow up on previous conceptual planning and the 2013 ***East Hants Strategic Plan*** which included the goal of "consideration of options related to public transportation within East Hants and between East Hants and Halifax Regional Municipality".

The study recommended a route (see Figure 1-1) that could be completed within one hour between Halifax Stanfield International Airport and Lantz with travel along Route 214 to the Aquatic Centre and Business Park, then along Highway 102 to the new (and at the time unfinished) Lantz Interchange. The proposed routing is shown in Appendix A, Map One. The plan went on to provide financial information and an assignment of operating responsibilities to be shared by the Municipality and East Hants Community Rider. The study provided preliminary advice on several issues related to the operation of the transit service including bus stops, maintenance, overnight storage, fares, and fare collection.

The study was presented on February 16, 2021 to the Corporate & Residential Services Committee.

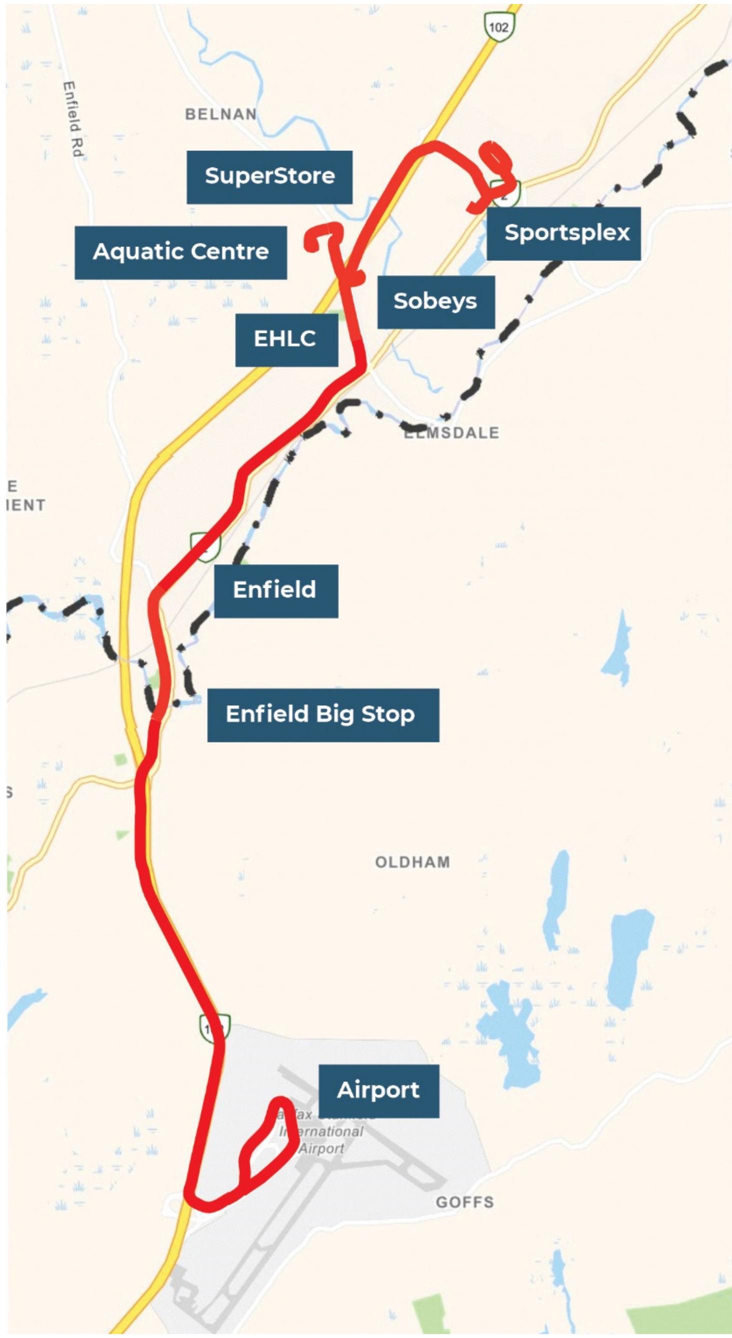

Figure 1-1: Proposed Route from 2020 Study

2 GOVERNANCE MODELS

2.1 JURISDICTIONAL SCAN

There are currently four municipal single-bus fixed-route systems within Nova Scotia. System operators in Antigonish, Pictou County, Bridgewater and Yarmouth were contacted and asked to provide information regarding their service. The results of that survey are provided in Table 2-1 This information will help to shape the East Hants service based on what has worked and what has been learned by similar systems. It is interesting to note that of the two governance models being considered in East Hants – a Municipally-operated system and a Community Not-for-Profit operated system – there are two instances of each currently in operation within Nova Scotia.

Table 2-1: Single Fixed Route Transit Services in Nova Scotia

	ANTIGONISH	PICTOU	BRIDGEWATER	YARMOUTH
Municipality coverage	Town of Antigonish Antigonish County	Town of New Glasgow Town of Stellarton	Town of Bridgewater	Town of Yarmouth
Service operator	Community NFP	Community NFP	Municipality	Municipality
Primary bus	Gas cutaway	Gas cutaway	Gas cutaway	Gas cutaway
Passenger seats (w/o wheelchairs)	16	18	19	16
Accessibility	Lift	Low-floor	Low-floor	Low-Floor
Bike racks	No	No	Yes	Yes
Backup bus	Owned	Owned	Owned	Owned
Weekday operating hours	7am - 7pm	7am - 9pm	6am - 8pm (Mon-Thu) 6am - 11pm (Fri)	7am - 7pm
Saturday operating hours	8am - 4pm	7am - 9pm	8am - 6pm	8am - 6pm
Sunday operating hours	no service	9am - 7pm	9am - 5pm	no service
Total weekly hours	68	94	80	70
Route length	20.0 km	22.6 km	16.9 km	13.2 km
Percentage of route flag stopping	100%	70%	70%	90%
Annual operating cost	$137,000	$270,000	$200,000	$195,000
Annual fare revenue	$13,000	$90,000	$45,000	$33,000
Annual ridership	7,200	50,000	36,000	14,300
Single adult cash fare	$2.00	$3.00	$2.00	$2.00
Single student cash fare	$2.00	$3.00	$1.50	$2.00
Single senior cash fare	$2.00	$3.00	$2.00	$2.00
Monthly adult pass	$55	$70	$45	$50
Monthly student pass	$55	$60	$30	$50
Monthly senior pass	$55	$60	$45	$50
Other fares	Day pass $5.00 20-day pass $55.00	Day pass $7.50	10-ride adult $18.00 10-ride student $13.50 Family rate $4.00	Tickets $1.50
Planned/recent service expansion		Adding a second connecting route with 4 runs per day		

NOTES: Community NFP are not-for-profit groups that operate local on-demand transit service

Although the four services included in the scan are similar to what is planned for East Hants in the sense that they run single-route one-hour service, there are significant differences. All four services do a one-hour "loop" within a town and do not connect to any other system. The service in East Hants does an "out-and-back" with a connection to Halifax Transit. With a one-hour loop, an origin-destination pair may take a 10 minute trip to get there, but would require a 50 minute trip (the other side of the loop) to return. With an out-and-back service the trip there and the trip back are typically the same length.

Another relevant analogy for East Hants, we believe, is the corridor service operated by Kings Transit in the Annapolis Valley. Although the scale of this service is much larger that the proposed East Hants service (seven buses over five routes), it has similar out-and-back routing, and travels through areas of high residential density. King's Transit has used transit-style buses for many years and is currently in the process of ordering new battery-electric 40-foot buses.

2.2 OPTIONAL MODELS FOR GOVERNANCE

There are several options for consideration in the operation of the fixed route service which are summarized in Table 2-2. Regardless of the option selected, careful integration with the existing on-demand service operated by East Hants Community Rider will be critical. This study will focus on the first two options listed, although opportunities to develop a provincial multi-system operator should be monitored and promoted where possible.

Table 2-2: Fixed Route Governance Options

Operator	Description	Examples
East Hants Community Rider	EHCR would operate the service with funding from the Municipality as well as other sources.	Antigonish Transit CHAD Transit (Pictou County)
Municipality of East Hants	The Municipality would operate the service itself, hiring staff and creating a Transit division within the organization.	Bridgewater, Yarmouth, HRM, CBRM
Multi-System Operator	Although we are aware of few examples, we believe Nova Scotia would benefit from having a single operator for multiple smaller non-contiguous transit systems. WSP has proposed this idea to the Joint Regional Transportation Agency. Kings Transit might be positioned to take on a role like this.	BC Transit[1]
Private Sector Operator	There are some private sector bus charter companies within Nova Scotia who could be procured through a tendering process to operate a fix route.	None currently providing public transit in Nova Scotia

[1] BC Transit, which began as the Urban Transit Authority in 1979 is a provincial crown agency charged with providing transit service throughout BC outside of the Greater Vancouver Area. Victoria Transit is the only service operated directly by BC Transit, while regional services in over fifty other communities are operated either by the municipality or by a private contractor. In addition to funding, the individual regional services receive high-level planning and operational support from BC Transit.

3 THE 2020 PLAN: WHAT HAS CHANGED

3.1 THE ROADWAY NETWORK

What the 2020 Plan Said

The 2020 Plan recognized that a new interchange on Highway 102 at Lantz was under construction along with a connector road to Trunk 2. Knowing that construction would be completed prior to transit service initiation, routing was based on this future connection. However, it was unknown whether there would be a roadway link from the connector road to Towerview Road in the Logan Drive Subdivision. The plan developed proposed routings with and without this connection (see Figure 3-1) but cautioned that without the connection, route timing would be tight and that direct service to the East Hants Sportsplex would need to be dropped.

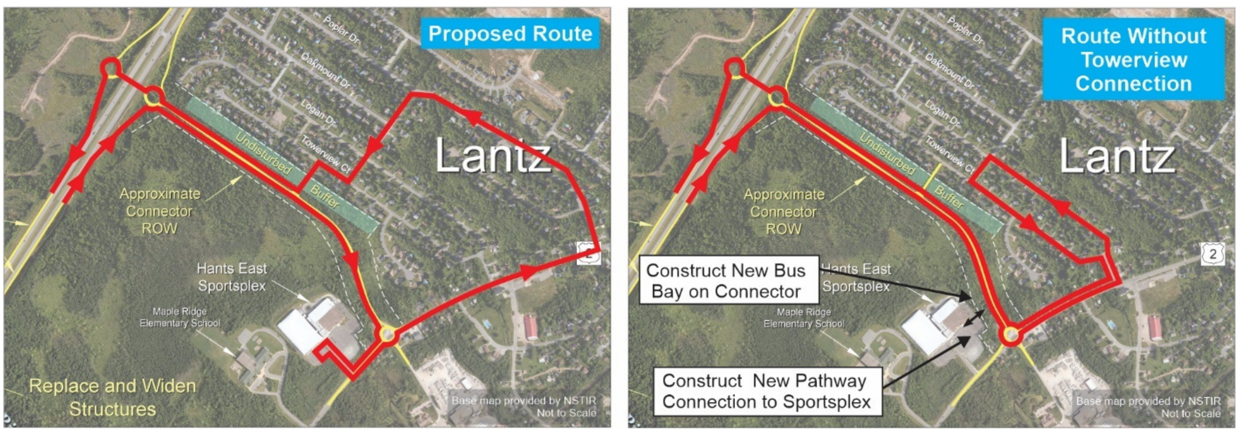

Figure 3-1: Original (2020) Planned Routing for the Lantz Area

What has Changed to Affect the 2024 Plan

The interchange and connector road opened for traffic in December 2021. However, no roadway connection was made to the Logan Drive Subdivision. Accordingly, reconsideration of routing in this area will be discussed in the next section.

3.2 DEVELOPMENT PLANS IN THE LANTZ AREA

What the 2020 Plan Said

Development to the south of the Lantz Connector had not been approved and was uncertain. No consideration was given in the 2020 Plan to servicing it with transit.

What has Changed to affect the 2024 Plan

A multi-use development and roadway layout plan for the lands to the south of the Lantz Connector prepared by Clayton Developments has been approved and is under construction. The plan for this area will result in a mixture of residential densities as well as commercial spaces. This has far greater potential for producing and attracting transit trips than single-family homes that make up the Logan Drive Subdivision.

With this in mind, we now propose abandoning the proposed service to the Logan Drive Subdivision in favour of service to the Clayton Lands. Following the 2020 Plan, and without a Towerview connection, the routing proposed would have been as shown in Figure 3-2. To service the Clayton Lands instead, the routing shown in Figure 3-3 is recommended. Taking these two routing plans, we have applied a 400m envelope from the route, which is considered to be the upper end of walking distance people will take to get to transit. We have determined how much residential and commercial development is, or is planned to be, within each of these envelopes and summarized that in Table 3-1.

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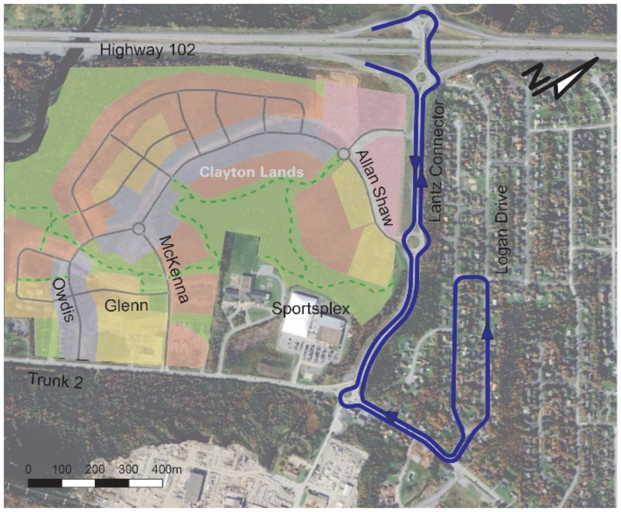

Figure 3-2: 2020 Routing

Figure 3-3: Proposed Routing

Table 3-1: Comparison of Logan Drive Subdivision with Clayton Lands

	Existing Logan Drive Subdivision	Future Clayton Lands
Residential Units within 400m of transit	310	1,600
Commercial Sq.Ft. within 400m of transit	10,000	100,000

It is clear from this comparison that the Clayton Lands, even though full build-out may be many years away, will have much greater ability to produce and generate transit trips. This routing also allows for a more direct connection to the Sportsplex, which will be an important destination for many transit trips.

Since Allan Shaw Boulevard is not yet connected through the Clayton Lands it may be necessary to operate an interim routing scheme while that work is completed. Should that be the case, an interim route plan is provided in Figure 3-4. The timing and performance of this route should be nearly identical to that of the proposed route.

Figure 3-4: Proposed Interim Routing Plan

3.3 EVOLUTION OF BATTERY-ELECTRIC BUSES

What the 2020 Plan Said

Both the 2015 and 2020 Plans recommended a gas bus in the range of 24-feet in length with a passenger capacity of 19-24. Some opportunities for acquiring a used vehicle of this description were identified. Because battery-electric technology for buses was still emerging, it was suggested that this be considered only when replacing the initially purchased bus in the future.

What has Changed to Affect the 2024 Plan

Diesel buses are amongst the loudest and most polluting vehicles in urban environments. It's not surprising, then, that many countries, with Canada near the top of the list, are promoting the conversion to battery-electric vehicles. Toronto and Vancouver have led the way in the move to battery-electric, and Halifax Transit put its first battery-electric bus (BEB) into service at the beginning of this year. Halifax Transit expects 59 more buses to be delivered before the end of 2024. To encourage the conversion to BEBs, the Federal Government has developed several programs that will be described more fully later in this report.

One aspect of BEBs that will impact the plan is that they have insufficient range to be able to do a typical twelve-hour shift without receiving a full or partial recharge. To deal with this, the plan will have to either employ two buses to do a full day of service or build bus dwell time and in-route charging infrastructure into the plan so that the battery can be topped-up throughout the service day.

The bus recommended in the 2020 Plan was a shuttle-type or "cutaway" bus. It is referred to as a cut-away because it is a bus shell that is built onto a truck chassis. This is different from a typical transit bus which is built as an integral vehicle. In addition to the cutaway buses being smaller with less seating capacity, they have an expected service life of 7-9 years which is about half of what would be expected for a transit bus. A comparison of bus types and characteristics is provided in Tables 3-2a and 3-2b.

Since the 2020 Plan, we have observed a significant increase in residential properties and high density of residential development along the corridor, particularly within Enfield and between Enfield and Elmsdale. Although significantly more expensive, a transit bus may be a more prudent investment, not only because of the extended service life, but to ensure that demand from increasing population can be accommodated on the bus.

3.4 OPERATING PARTNERSHIP

What the 2020 Plan Said

The 2020 Plan envisioned a partnership between the Municipality and East Hants Community Rider where the EHCR would be the operator, but the Municipality would take on some of the burden of risk to ease the impact of taking on this new aspect of service for EHCR.

What has Changed to Affect the 2024 Plan

We have learned from the Municipality's insurer that it will be impractical to insure the Municipality for aspects of responsibility that it assumes but lacks having effective control over. Accordingly, it will be necessary to consider models where 100% of the operating responsibility falls on either the Municipality or EHCR.

Category	Detail					
General information	Manufacturer	Nova Bus	New Flyer	New Flyer	BYD	BYD
	Model Name	LFSe+	Xcelsior CHARGE NG	Xcelsior CHARGE NG	K9MD	K8M
	Availability	Yes	Yes	Yes	Yes	Yes
Specifications	Bus Length (ft)	40	40	35	40	35
	Passenger Capacity (seats + standees)	41+27	40+44	32+35	42 + standees	32 + standees
	Bus Weight (lbs)	35,280	32,860	51,705	35,140	32,120
	Dimensions (L x W x H ft)	40' by 8'6" by 10'8"	41' by 8'6" by 11'1"	36'3" by 8'6" by 11'1"	40.9' by 8'6" by 11'2"	35.8' by 8'6" by 11'2"
	Floor Type	low floor	low floor	low floor	low floor	low floor
Performance	Energy Consumption (kWh/km)	1.32 (Altoona UDDS cycle)	1.21 or 1.22 or 1.25	1.18 or 1.21	1.19 (Altoona UDDS cycle)	1.19 (Altoona UDDS cycle)
	Range (km)	427	286 or 356 or 415	293 or 360	375	329
	Top Speed (km/h)		105	105	105	105
	Battery Capacity (kWh)	564	345 or 435 or 520	345 or 435	446	391
	Charging Time (hours)	<3.25	<3.8 (520 kWh)	<3.8 (520 kWh)	<3.5	<3.5
	Charging Type	SAE J3105 and J1772	SAE J3105 and J1772	SAE J3105 and J1772	J1772	J1772
	Motor Power (kW)	200	160 or 209	160 or 209	180x2	150x2

Table 3-2a: Transit Bus Comparison

Category	Detail				
General information	Manufacturer	BYD	BYD	GreenPower	GreenPower
	Model Name	K7MER	C6M	EV350	EV Star
	Availability	Yes	Yes	Yes	Yes
Specifications	Bus Length (ft)	30	23.4	40	25
	Passenger Capacity (seats + standees)	20 + 21	18 + 0	40 + 25	19 + 0
	Bus Weight (lbs)	29,010	13,395	33,440	14,330
	Dimensions (L x W x H ft)	29.9' by 8.5' by 11.2'	23.4' by 6.8' by 9.3'	40'4" by 8'4" by 10'6"	25' by 6.6' by 9.7'
	Floor Type	low floor	Has two wheel chair spots	low floor	Not low floor, but can have lift
Performance	Energy Consumption (kWh/km)	1.10 (Altoona UDDS cycle)	0.62	1.18	0.43 (Altoona UDDS cycle)
	Range (km)	285	227	341	253
	Top Speed (km/h)	105	105	109	109
	Battery Capacity (kWh)	313	141	400	118
	Charging Time (hours)	<2.5	<1.5	<2.75	<2 (DC) or <8 (level 2)
	Charging Type	J1772	J1772	J1772	J1772 and wireless
	Motor Power (kW)	150x2	110x2	350	150

Table 3-2b: Transit Bus Comparison

3.5 JOINT REGIONAL TRANSPORTATION AGENCY

What the 2020 Plan Said

In 2020, the Province of Nova Scotia had little interest in municipal fixed route transit and no mention of their potential involvement was made in the report.

What has Changed to Affect the 2024 Plan

The Joint Regional Transportation Agency (JRTA) was created by the Province in December 2021 to guide the collaborative development and implementation of a Regional Transportation Plan for the Halifax Regional Municipality and surrounding communities. The incentive for this work is to build a capability for the Halifax Region to grow significantly in the future while being able to accommodate that growth outside of the Halifax urban core supported by the creation of strong and sustainable transportation connections.

When interviewed by the WSP team and Municipal staff in relation to the East Hants transit project, the JRTA representative advised that their plan is likely to recommend some type of regional bus or rail service along the Highway 102 corridor with frequencies potentially in the range of 4 to 6 buses or trains in each direction every weekday.

This future regional bus/rail service provides some interesting opportunities to extend the reach of the proposed East Hants fixed route through timed connections to the regional service. It may create an opportunity to end the East Hants route at Enfield and connect to the Airport through transfer. More likely, however, the reduced frequency of the regional service compared to the East Hants hourly service may necessitate both routes travelling to the Airport. If a rail opportunity is pursued, the East Hants bus connection may serve as a link between the rail service from the north the airport, as existing rail lines do not come within proximity of the airport.

It is also likely that implementation of the East Hants service will occur well before implementation of regional service. For the current work, we will continue to design the East Hants service as stand-alone (other than its connection to Halifax Transit at the Airport) but keep in mind opportunities to connect to regional bus service at Highway 102 transfer points or to rail service along the CN main line.

3.6 THE AIRPORT

What the 2020 Plan Said

Using the existing bus stop on the departures level of the Halifax Stanfield International Airport was recommended to allow for effective connection to Halifax Transit buses.

What has Changed to Affect the 2024 Plan

The recommended connection point remains unchanged. If BEBs were to be used for the East Hants service, the Airport stop may be a possible candidate for in-route charging. When interviewed by the WSP team, an Airport representative indicated no concern with installing and operating in-route charging on their property. While they are evaluating conversion to electric for their own fleet vehicles, they anticipate that a more likely outcome is for them to move towards hydrogen cell energy and install infrastructure on-site to support that technology.

3.7 STOPPING ON ROUTE 214 NEAR THE ELMSDALE (SOBEYS) PLAZA

What the 2020 Plan Said

Buses travelling westbound on Route 214 were to stop for passengers in the right turn bay at the approach to the signals at the Elmsdale Plaza driveway.

What has Changed to Affect the 2024 Plan

Through recent discussion with N.S. Public Works staff, a degree of concern was raised regarding buses stopping near the approaches to signalized intersections. We now believe that location selected in the 2020 Study will not be approved. The only option to locating a stop there is for the bus to enter the Elmsdale Plaza (see Figure 3-5). Although this will add a small amount of time to the route and raises some concern with interaction with parking lot traffic, we believe this modification to the route is justified. On the positive side, this routing provides a higher level of service to riders destined for the Plaza.

Figure 3-5: Route Entering Elmsdale Plaza

4 FEASIBILITY OF BATTERY-ELECTRIC BUSES

4.1 INTRODUCTION

The feasibility analysis will provide high-level assessment of whether BEBs can complete the designed services identified in the 2020 Plan with modifications described in Section 3.2. This plan is summarized in Table 4-1.

Table 4-1: Proposed Operating Plan

	Increment (min)	Time Point
Airport depart	6	0:15
Enfield Big Stop	7	0:22
Enfield	2	0:24
Trunk 2/Rte 214	6	0:30
Learning Centre	1	0:31
Superstore	2	0:33
Aquatics Centre	1	0:34
Alan Shaw Blvd	4	0:38
Sportsplex arrive	2	0:40
Sportsplex depart	2	0:42
Alan Shaw Blvd	4	0:46
Superstore	3	0:49
Aquatics Centre	1	0:50
Learning Centre	3	0:53
Trunk 2/Rte 214	1	0:54
Enfield	6	1:00
Enfield Big Stop	2	1:02
Airport arrive	7	1:09

BEBs typically have insufficient battery capacity to complete a full day of service without periodic recharging or swapping out for a fully charged bus. Accordingly, daily deployment of a BEB requires a degree of strategic planning that is not needed with a diesel or gas bus.

Four scenarios are evaluated as part of this analysis:

- Scenario 1: One 35ft BEB using one high-power on-route charger at the airport stop and one charger at the depot
- Scenario 2: Two 35ft BEBs using only depot chargers
- Scenario 3: Two 25ft BEBs using only depot chargers
- Scenario 4: Three 25ft BEBs using only depot chargers

Note that only 35ft, 40ft and 60ft BEBs are currently equipped with devices to use high-power on-route chargers. When operating a single bus, service frequency needs to remain hourly throughout the day. However, deploying more than one BEB supports higher service frequency, such as every 30 minutes during rush hours.

4.2 ASSUMPTIONS

Table 4-2 shows the technical assumptions used in this feasibility study, which serves as the foundation for analysing the possible performance of BEBs. Note that the energy efficiencies for BEBs are lower than their test results from Altoona test. This discrepancy arises because the Altoona tests usually do not account for winter conditions with electric heating. For feasibility studies, it is important to consider the worst-case scenario which is winter condition using electric heating for East Hants. Additionally, it is important to note that factors such as route topography and driver behaviour can also impact the performance of BEBs, which is not specifically accounted for in this study.

Table 4-2: List of Assumptions

No.	Description of assumptions
1	The nominal battery size for a 25ft BEB is 118 kWh.
2	The energy efficiency for a 25ft BEB is 0.52 kWh/km.
3	The maximum output power of a depot charger for 25ft BEBs is 60 kW.
4	The nominal battery size for a 35ft BEB is 435 kWh.
5	The energy efficiency for a 35ft BEB is 1.4 kWh/km.
6	The maximum output power of a depot charger for 35ft BEBs is 150 kW.
7	The maximum output power of an on-route charger is 450 kW.
8	The on-route charger is located at the airport.
9	BEBs have four minutes to be charged by on-route charger per round trip. (total 6 minutes are allocated at the airport stop).
10	The efficiency of all chargers is 90%.
11	80% of the battery capacity is usable.
12	The depot location is at the learning centre, with pull-out and pull-in trips being approximately 3 km each.
13	It takes 15 minutes for BEBs to travel from the depot at learning centre to the starting stop at Sportsplex.
14	It takes 15 minutes for BEBs to travel from last stop at Sportsplex to the depot for charging.
15	Service operates from 6:41 to 19:41 on weekdays.
16	Peak hours are from 6:30 to 9:00 and from 16:00 to 19:00.

4.3 MODELLING SCENARIOS

Four scenarios will be explored, each involving different types of buses and/or charging strategies. These scenarios will be used as “building blocks” to develop a service model that is effective, reliable, expandible, and meets the practical needs of the Municipality as a first step in implementing service.

4.3.1 ONE 35FT BEB USING ONE HIGH-POWER ON-ROUTE CHARGER AND DEPOT CHARGER

Using one 35ft BEB allows constant service frequency for every hour throughout the day. This scenario uses one on-route charger at the Airport for a period of 4 mins in every round trip. At night, the BEB will be charged at the depot. The total number of round trips is 13 in a day. The estimated available battery energy is 348 kWh. The energy usage for one round trip is approximately 57.7 kWh and for each pull-out/pull-in trip is about 4.2 kWh. For each round trip, the BEB can get extra 27.0 kWh energy from on-route charger which means the battery energy drops about 30.7 kWh per round trip.

Figure 4-1 shows the energy level in a graph which also shows the influence of the on-route charger on battery's energy level. In the last two trips (12 and 13), the energy level is below the green line, representing the 0 level. Extending the charging time at the airport by an additional 2 minutes would enable the BEB to complete all 13 round trips successfully. The small segments at beginning and end of the day are pull-out and pull-in trips.

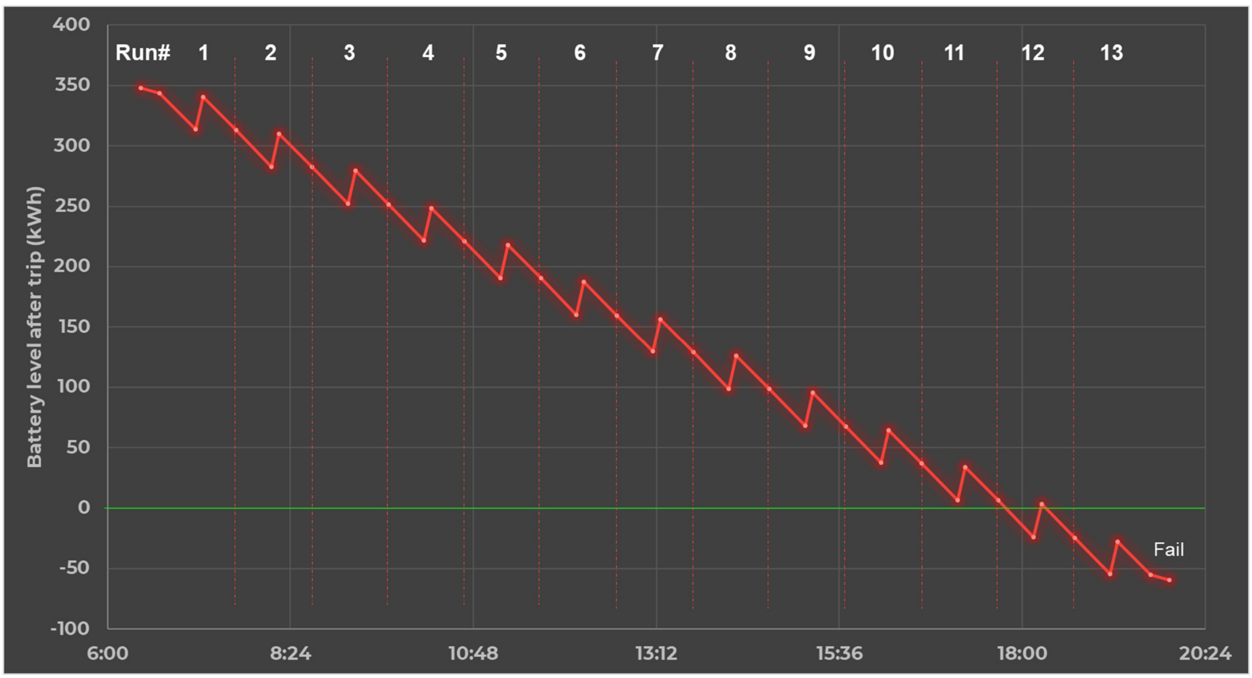

Figure 4-1: Battery Level for Scenario One (One 35' BEB) over a One Day Period

Table 4-3 presents the trip schedule and battery energy levels for a single 35ft BEB. Despite the on-route charging, the battery energy continues to decline throughout the day. By the last two trips, the battery level drops below 0, indicating the failure of the BEB completing the last two round trips of the service.

Table 4-3: Service Schedule and Battery Level for Scenario One (One 35' BEB) over a One Day Period

	Round Trip	Start Time	End time	Battery level at the end (kWh)	Completion?
One BEB	1	6:41	7:41	313	Yes
	2	7:41	8:41	282	Yes
	3	8:41	9:41	252	Yes
	4	9:41	10:41	221	Yes
	5	10:41	11:41	190	Yes
	6	11:41	12:41	160	Yes
	7	12:41	13:41	129	Yes
	8	13:41	14:41	98	Yes
	9	14:41	15:41	68	Yes
	10	15:41	16:41	37	Yes
	11	16:41	17:41	6	Yes
	12	17:41	18:41	-24	No
	13	18:41	19:41	-59	No

The analysis demonstrates that the use of a 35ft BEB with on-route charging cannot support a consistent service frequency throughout the day and the current charging schedule is insufficient to sustain operations during peak hours with higher service frequency. The battery energy level gradually depletes, ultimately resulting in an inability to complete the last two round trips.

4.3.2 TWO 35FT BEBS USING ONLY DEPOT CHARGERS

In this scenario, BEBs do not get on-route charging at the Airport, instead, they only get charged at the depot whenever there is downtime, either during the day or overnight. When operating two BEBs, the service frequency can be doubled during peak hours, as both BEBs can run simultaneously to meet increased demand. In this scenario, the total number of round trips under this scenario increases to 18. Although on-route charging is not considered, the BEBs can have mid-day charging at the depot which requires careful planning and precise trip assignment.

Figure 4-2 shows the energy level throughout the day. It shows that Bus B goes back to depot twice for mid-day charging while Bus A goes back to depot once during the day for charging. Both BEBs go back to depot for overnight charging after their last runs. The figure shows a potential arrangement of the two 35ft BEBs to have successful services. Each BEB is running nine round trips in a day, effectively sharing the service load. Table 4-4 shows the schedule for each round trip and energy charged at the depot for both BEBs.

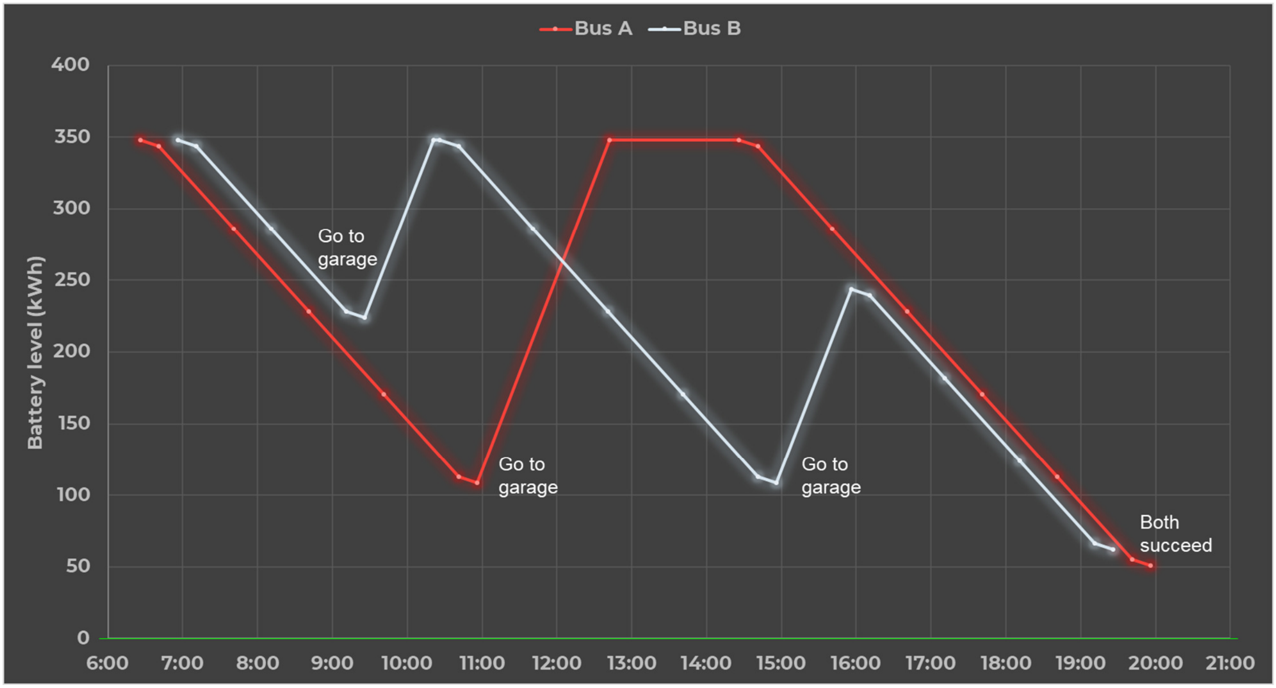

Figure 4-2: Battery Level for Scenario Two (Two 35' BEBs) over a One Day Period

Table 4-4: Service Schedule and Battery Level for Scenario Two (Two 35' BEBs) over a One Day Period

	Round Trip	Start Time	End time	Bus	Battery level after trip (kWh)	Back to garage for charging?	Charge Start	Charge End	Charge Time (Hour)	Charged Energy (kWh)
Peak hour Two buses	1	6:41	7:41	A	286	No				
	2	7:11	8:11	B	286	No				
	3	7:41	8:41	A	228	No				
	4	8:11	9:11	B	224	Yes	9:26	10:26	1	124
One bus	5	8:41	9:41	A	171	No				
	6	9:41	10:41	A	109	Yes	10:56	14:26	3.5	239
	7	10:41	11:41	B	286	No				
	8	11:41	12:41	B	228	No				
	9	12:41	13:41	B	171	No				
	10	13:41	14:41	B	109	Yes	14:56	15:56	1	135
	11	14:41	15:41	A	286	No				
	12	15:41	16:41	A	228	No				
Peak hour Two buses	13	16:11	17:11	B	182	No				
	14	16:41	17:41	A	171	No				
	15	17:11	18:11	B	124	No				
	16	17:41	18:41	A	113	No				
	17	18:11	19:11	B	62	Yes (overnight)	19:26	6:56 (next day)	11.5	286
	18	18:41	19:41	A	51	Yes (overnight)	19:56	6:26 (next day)	10.5	297

This scenario shows that two 35ft BEBs can successfully complete all 18 trips and each BEB runs 9 round trips during a day. However, since a 35ft BEB can be expensive, it is important to check the cheaper option of 25ft BEB as we do in the next scenario.

4.3.3 TWO 25FT BEBS USING ONLY DEPOT CHARGERS

In this scenario, the two 25ft BEBs do not have access to on-route chargers and only uses depot chargers for mid-day and overnight charging. The main benefits of using 25ft BEBs is lower CAPEX and OPEX when compared with 35ft BEBs. Since the projected ridership may be lower than a large urban service, 25ft BEBs could be a viable option for the near future. A potential issue that will need to be addressed is that for 25ft BEBs the battery range is less than for 35ft BEBs.

In this scenario, two 25ft BEBs are scheduled to run 18 round trips (double frequency during rush hours), providing the same frequency as the scenario with two 35ft BEBs. To complete one round trip, a 25ft BEB can use about 21.2 kWh, significantly lower than 35ft BEBs. Each pull-out or pull-in trip will use about 1.5 kWh for a 25ft BEB. The usable battery capacity (80% of total capacity) for 25ft BEBs is about 94 kWh. The depot charger for the 25ft BEB is rated at 60 kW, which is lower than the 150kW charger needed for the 35ft BEB due to smaller battery size.

Figure 4-3 shows the battery level throughout the day using two 25ft BEBs for one day's service. Table 4-5 shows the service schedule and energy level at the end of each trip. The operating schedule is the same as two 35ft BEBs in the previous session. Bus B goes to depot twice during the day for charging while Bus A goes to depot once during the day. Both BEBs are running 9 round trips for a day. Although the 25ft BEBs are much more efficient than the 35ft BEBs, the selected battery size does not allow two 25ft BEBs to complete all 18 trips; the last trip falls short by a small margin. However, only the last trip is not completed with a small deficiency. Note that the energy efficiency applied for 25ft BEBs is based on the winter conditions using electric heating which is the worst-case scenario. If a diesel heater is used instead of electric heater, then the two 25ft BEBs can complete the 18 round trips.

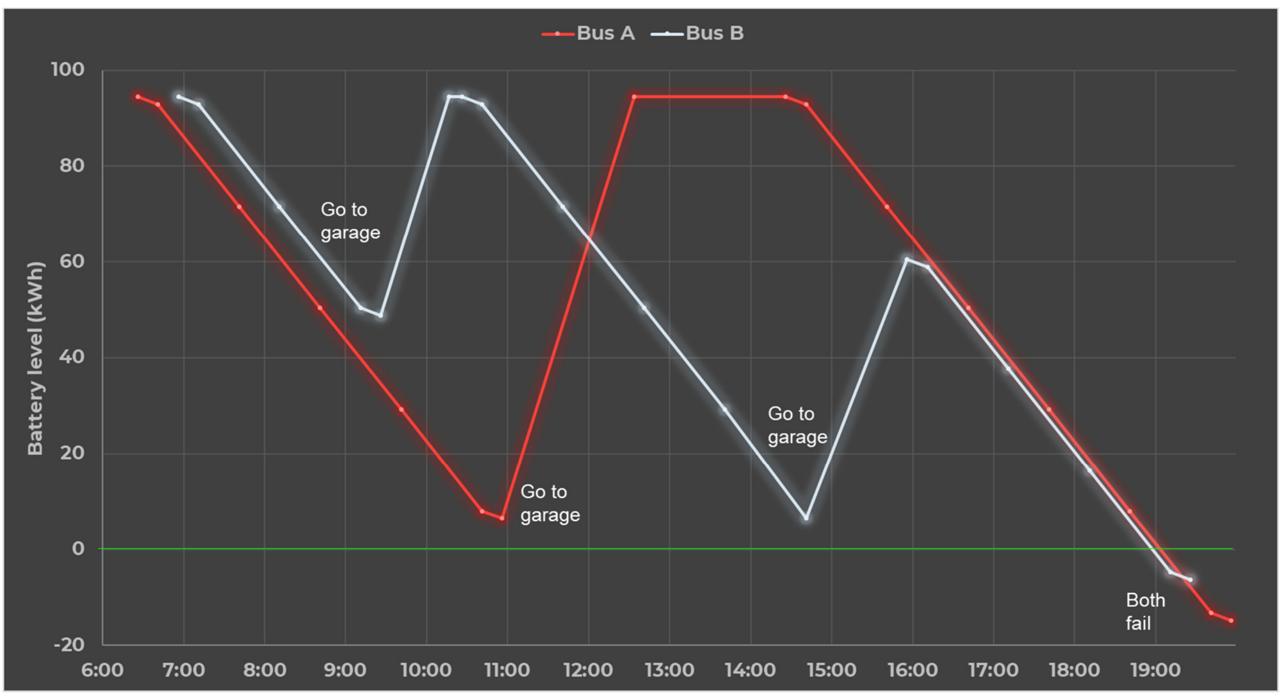

Figure 4-3: Battery Level for Scenario Three (Two 25' BEBs) over a One Day Period

Table 4-5: Service Schedule and Battery Level for Scenario Three (Two 25' BEBs) over a One Day Period

	Round Trip	Start Time	End time	Bus	Battery level after trip (kWh)	Go back to garage for charging?	Charge Start	Charge End	Charge time (Hour)	Charged Energy (kWh)
Peak hour Two buses	1	6:41	7:41	A	72	No				
	2	7:11	8:11	B	72	No				
	3	7:41	8:41	A	50	No				
	4	8:11	9:11	B	49	Yes	9:26	10:26	1	46
One bus	5	8:41	9:41	A	29	No				
	6	9:41	10:41	A	6	Yes	10:56	14:26	3.5	88
	7	10:41	11:41	B	72	No				
	8	11:41	12:41	B	50	No				
	9	12:41	13:41	B	29	No				
	10	13:41	14:41	B	6	Yes	14:56	15:56	1	54
	11	14:41	15:41	A	72	No				
	12	15:41	16:41	A	50	No				
Peak hour Two buses	13	16:11	17:11	B	38	No				
	14	16:41	17:41	A	29	No				
	15	17:11	18:11	B	16	No				
	16	17:41	18:41	A	8	No				
	17	18:11	19:11	B	-6	Yes (overnight)	19:26	6:56 (next day)	11.5	100
	18	18:41	19:41	A	-15	Yes (overnight)	19:56	6:26 (next day)	10.5	109

This scenario shows that two 25ft BEBs cannot complete the desired service every day. Adding more BEBs to the fleet could solve this issue and will be examined in the next scenario.

4.3.4 THREE 25FT BEBS USING ONLY DEPOT CHARGERS

In this scenario, three 25ft BEBs are used without an on-route charger, but mid-day and overnight charging at the depot is needed. When using three 25ft BEBs, many different arrangements can be used to complete the service. Figure 4-4 shows the energy level changes in a graph. Both Bus A and Bus C complete three consecutive round trips before returning to depot for recharging, and then proceed to complete another three round trips with ample energy remaining. Meanwhile, Bus B starts with two round trips, recharged fully at the depot, and then completes four additional round trips, finishing with a minimal but sufficient energy reserve. All three BEBs only go to depot once for mid-day charging. Table 4-6 shows one of the successful arrangements for all three BEBs. Each BEB is equally scheduled for 6 round trips.

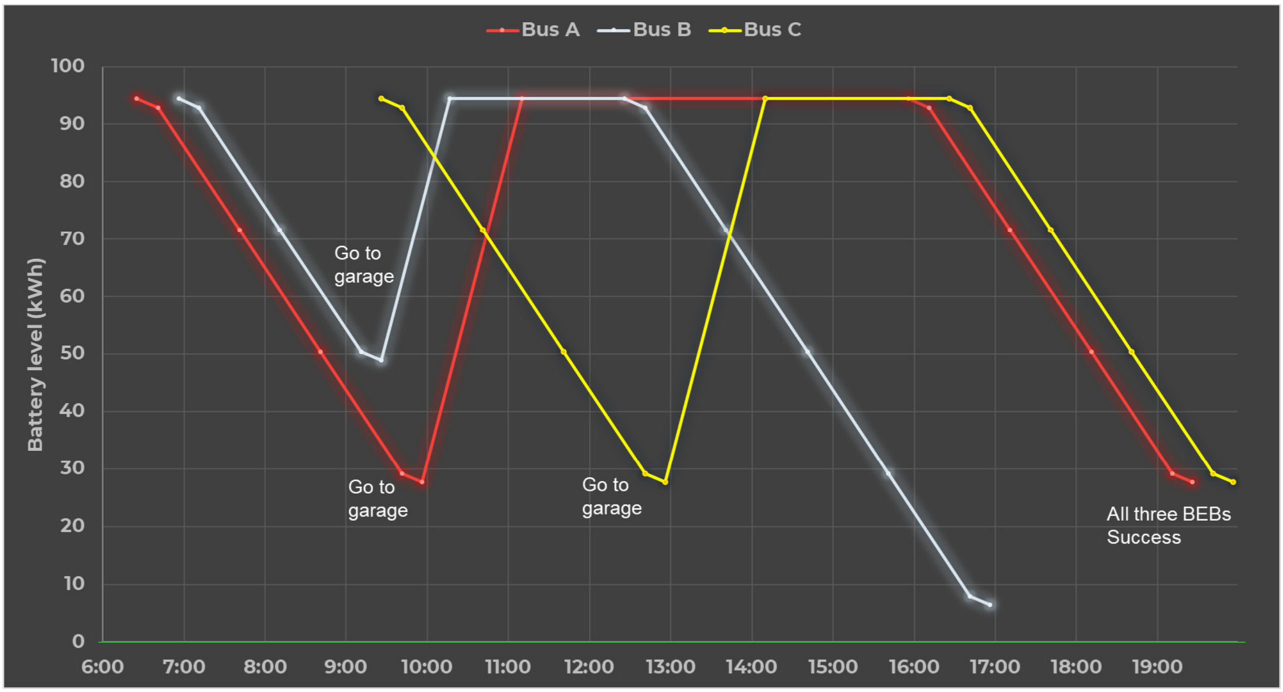

Figure 4-4: Battery Level for Scenario Four (Three 25' BEBs) over a One Day Period

Table 4-6: Service Schedule and Battery Level for Scenario Four (Three 25' BEBs) over a One Day Period

	Round Trip	Start Time	End time	Bus	Battery level after trip (kWh)	Go back to garage for charging?	Charge Start	Charge End	Charge time (Hour)	Charged Energy (kWh)
Peak hour Two buses	1	6:41	7:41	A	72	No				
	2	7:11	8:11	B	72	No				
	3	7:41	8:41	A	50	No				
	4	8:11	9:11	B	49	Yes	9:26	12:26	3:00	46
One bus	5	8:41	9:41	A	28	Yes	9:56	15:56	6:00	67
	6	9:41	10:41	C	72	No				
	7	10:41	11:41	C	50	No				
	8	11:41	12:41	C	28	Yes	12:56	16:26	3:30	67
	9	12:41	13:41	B	72	No				
	10	13:41	14:41	B	50	No				
	11	14:41	15:41	B	29	No				
	12	15:41	16:41	B	6	Yes (overnight)	16:56	6:56	14:00	88
Peak hour Two buses	13	16:11	17:11	A	72	No				
	14	16:41	17:41	C	72	No				
	15	17:11	18:11	A	50	No				
	16	17:41	18:41	C	50	No				
	17	18:11	19:11	A	28	Yes (overnight)	19:26	6:26	11:00	66
	18	18:41	19:41	C	28	Yes (overnight)	19:56	9:26	13:30	66

This scenario shows that by adding one more 25ft BEB to the other two 25ft BEBs will allow successful completion of desired service schedule.

4.4 SUMMARY OF FEASIBILITY ANALYSIS

Table 4-7 summarizes the outcomes of the feasibility analysis with four scenarios. The scenario with one 35ft BEBs (348 kWh usable energy) using on-route charger showed the worst performance, failing to complete the schedule without requiring extra runs during peak hours. In contrast, two 25ft BEBs (94.4 kWh usable energy) failed the service only by a small amount of energy. With slightly larger batteries or increased utilization of the total battery capacity or use diesel heater in winter, then this scenario could be viable. Both scenarios of two 35ft BEBs and three 25ft BEBs were successful.

The next step will involve conducting cost and GHG emissions analysis for the selected scenario.

Table 4-7: Feasibility Analysis Summary

Scenario #	Scenario Description	Result
1	One 35ft BEB with on-route charger and depot charger	Fail
2	Two 35ft BEBs with only depot charger	Pass
3	Two 25ft BEBs with only depot charger	Fail
4	Three 25ft BEBs with only depot charger	Pass

5 SELECTION OF OPERATING STRATEGIES FOR ANALYSIS

Following up on areas discussed in the previous sections, a set of alternative operating strategies will be developed for analysis. To create these strategies, various elements of service will be defined while others left flexible. Those elements are described in the sections following.

5.1 FUNDAMENTALS

Following discussion with the East Hants project team, the following service elements were agreed to and will be set as common for all the strategies to the modelled:

Primary vehicles to be used will be transit-style 35-foot buses. Compared to shuttle-type buses, purpose-built onto truck chassis, it was recognized that a transit-style bus will provide value in its longer service life, improved comfort for passengers and greater seating capacity to meet expected demand peaks.

Overnight storage and charging of BEB (if applicable) will be done at the Sportsplex. This location seemed ideal for this purpose as it is directly on the planned route, is property owned by the Municipality, has area available for this purpose, and may be aligned with plans by the facility to convert to battery-electric ice maintenance vehicles.

5.2 SERVICE FREQUENCY ALTERNATIVES

The basis of the schedule developed in the 2020 Plan was to operate hourly service that is timed to connect with Halifax Transit route 320 at the Airport at 7:09am through to 7:09pm Monday through Friday. With the Route 320's first arrival at the Airport at 5:12am, final departure at 12:15am, and thirty-minute service during commuter peak periods, this leaves a number of times during the day where there is no East Hants bus to connect to the Route 320 bus.

To address this, an alternative with a higher level of service frequency was developed. In this alternative, the service day for the East Hants bus is extended at both ends of the day and service is increased to thirty-minute frequency during the commuter peaks.

These service alternatives will be referred to a Phase One and Phase Two, as it may be prudent to offer the lower service frequency initially to confirm ridership levels. Sound performance of the Phase One service level may then warrant expanding service to the Phase Two level.

Schedule timing for the two phases is shown in Table 5-1. This table also illustrates which Halifax Transit buses are connected to by the East Hants bus.

Why is it important to consider moving to higher frequency service? From our observation of other public transit services in Nova Scotia, one hour transit service meets the needs of only a small portion of the population. Social, recreational and shopping trips are not as dependant on transit frequency as those trips normally have flexibility to be scheduled to match the transit schedule. Trips to work, school and appointments, however, generally have fixed start and end times which may not match the arrival and departure of buses and significant waiting time may be incurred. Because of this, we observe the one-hour transit services in Nova Scotia cater predominantly to seniors and less to students and workplace employees.

In explaining the importance of frequency, transit expert Jarrett Walker[2] paints this analogy:

> "…imagine that there were an automated gate at the end of your driveway that only opened once an hour, on the hour. When it's closed, you can't get your car in or out. If that were your situation, your biggest transportation problem would not be traffic congestion, or how fast you can go on the freeway; it would be how to get this frigging gate to open more often. That's how low frequency feels to a potential transit customer, and why frequency often swamps other factors, like speed, in determining whether transit is actually useful."

Table 5-1: Service Schedule by Phase

PHASE ONE				PHASE TWO			
EAST HANTS TRANSIT		HALIFAX TRANSIT		EAST HANTS TRANSIT		HALIFAX TRANSIT	
Depart Sportsplex	Depart Airport	Depart Airport	Arrive Scotia Sq	Depart Sportsplex	Depart Airport	Depart Airport	Arrive Scotia Sq
		5:45	6:40			5:45	6:40
		6:15	7:10	5:40	6:15	6:15	7:10
		6:45	7:40	6:10	6:45	6:45	7:40
6:40	7:15	7:15	8:10	6:40	7:15	7:15	8:10
		7:45	8:40	7:10	7:45	7:45	8:40
7:40	8:15	8:15	9:10	7:40	8:15	8:15	9:10
		8:45	9:40	8:10	8:45	8:45	9:40
8:40	9:15	9:15	10:10	8:40	9:15	9:15	10:10
9:40	10:15	10:15	11:10	9:40	10:15	10:15	11:10
10:40	11:15	11:15	12:10	10:40	11:15	11:15	12:10
11:40	12:15	12:15	13:10	11:40	12:15	12:15	13:10
12:40	13:15	13:15	14:10	12:40	13:15	13:15	14:10
13:40	14:15	14:15	15:10	13:40	14:15	14:15	15:10
14:40	15:15	15:15	16:10	14:40	15:15	15:15	16:10
15:40	16:15	16:15	17:10	15:40	16:15	16:15	17:10
		16:45	17:40	16:10	16:45	16:45	17:40
16:40	17:15	17:15	18:10	16:40	17:15	17:15	18:10
		17:45	18:40	17:10	17:45	17:45	18:40
17:40	18:15	18:15	19:10	17:40	18:15	18:15	19:10
		18:45	19:40	18:10	18:45	18:45	19:40
18:40	19:15	19:15	20:10	18:40	19:15	19:15	20:10
		20:15	21:10	19:40	20:15	20:15	21:10
		21:15	22:10			21:15	22:10
		22:15	23:10			22:15	23:10
		23:15	0:10			23:15	0:10
		0:15	1:10			0:15	1:10

Walker goes on to provide data from several United States transit systems showing productivity (ridership per unit of service cost) versus service frequency. That data is shown in Figure 5-1. One might think that going from service every sixty minutes to service every thirty minutes might dramatically reduce productivity since the service cost will essentially double.

[2] Walker, Jarrett; Human Transit; Island Press; 2011

If anything, productivity increases, implying that doubling the frequency (from sixty-minute to thirty-minute service) can more than double ridership. This should not be unexpected however, given that the reduced waiting time will make the service more attractive to a much greater segment of the population.

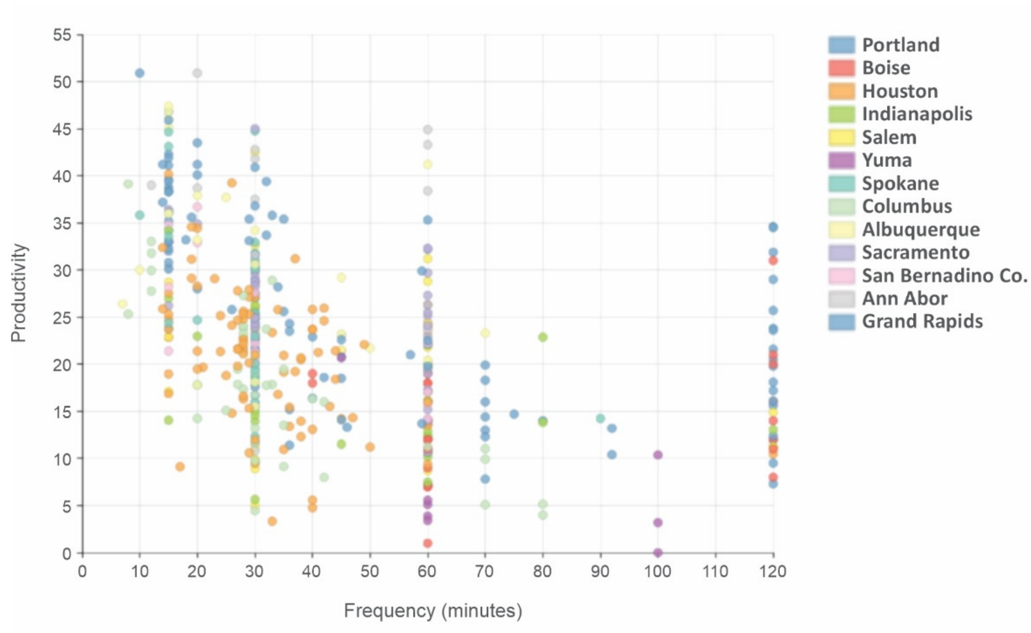

Figure 5-1: Productivity Versus Service Frequency in Selected U.S. Cities

5.3 VEHICLE ALTERNATIVES

We will examine strategies using both diesel buses and battery-electric buses. Both types of transit bus are available in the selected 35-foot length from several different manufactures. It will be assumed that buses will be purchased new, as the availability of used 35-foot diesel buses is very limited and is non-existent for battery-electric. Purchasing a second-hand shuttle-type bus for use as a spare will be considered. For reference, a 35-foot bus is slightly shorter that the 40-foot buses which make up the bulk of the Halifax Transit fleet.

For the Phase One service level described above a single new diesel bus will be required along with a spare. The spare bus may be purchased new or second-hand. If a new bus is purchased, it is best to alternate the two buses weekly rather than use one bus regularly and the other only as a spare. Both Bridgewater Transit and Yarmouth Transit have two identical buses that they alternate in their single-route-single-bus service. With BEBs, the primary BEB will have sufficient range to operate for only a portion of the day. A spare diesel bus (transit-type or shuttle-type purchased new or used) would be employed to fill in those service gaps. When the BEB requires servicing, the diesel bus would be employed. When the diesel bus requires servicing, measures would need to be taken to lease a bus. Of course, two new BEBs could be purchased, but this would be a significant up-front investment for limited service.

For the Phase Two service level, a second bus would be acquired for both strategies. For the BEB strategy, the diesel bus used for part-day service would be relegate to strictly a role as a spare. In the diesel bus strategy, a new bus would be acquired. If two new buses were purchased to do alternating service in Phase One, they could then be employed for full-day service and a new or used third bus would be acquired as a spare (or put into a three-bus rotation).

A summary of the bus acquisition plan for each strategy is shown in Figure 5-2.

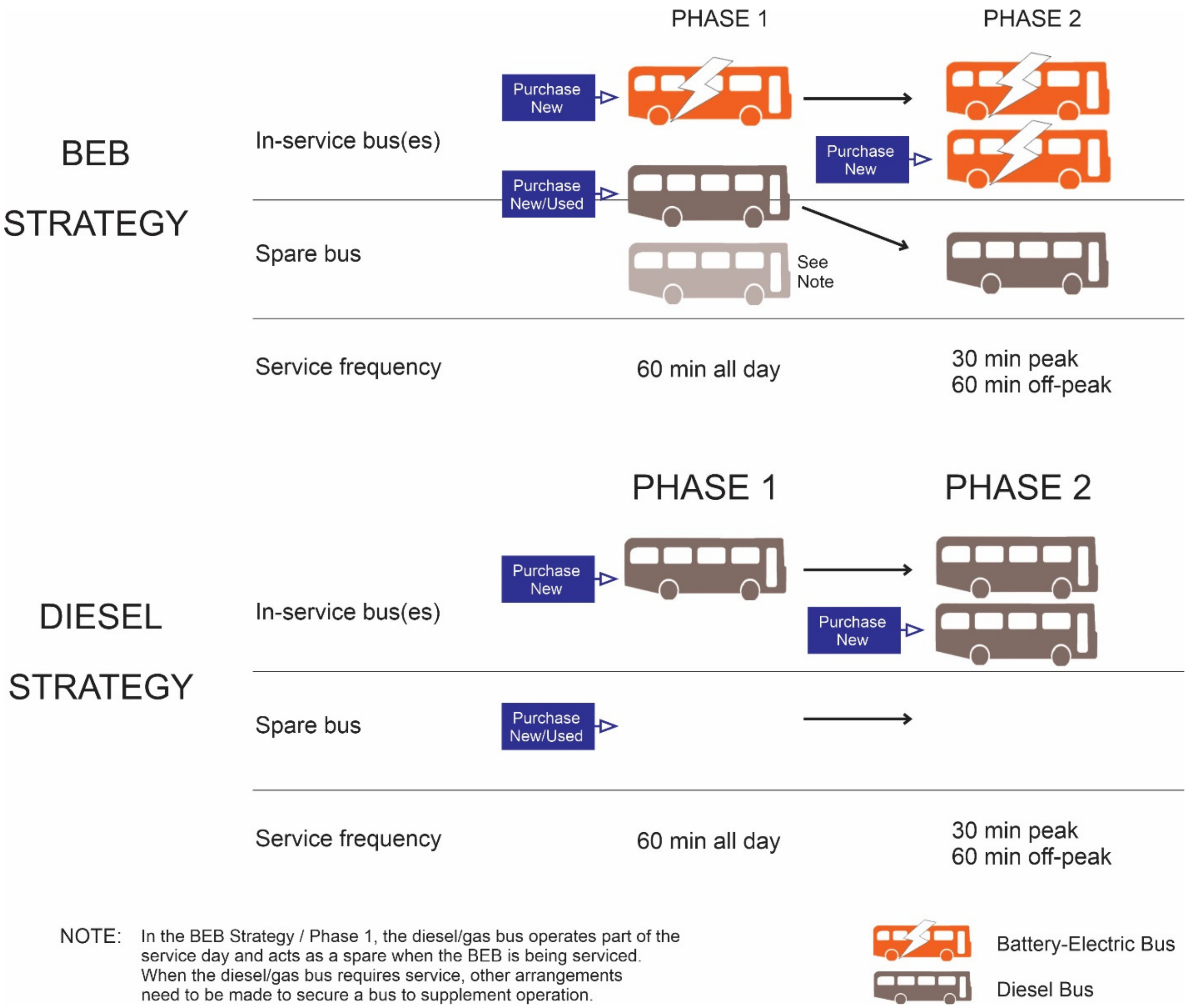

Figure 5-2: Bus Acquistion by Strategy

5.4 DESCRIPTION OF STRATEGIES

Combining the two service frequency alternatives and the two vehicle alternatives described in the previous sections results in four strategies. Those strategies are illustrated below using time-of-day tables that show energy consumption (and recharging if applicable) for each of the vehicles in service.

5.4.1 BEB STRAGEGY / PHASE ONE

In BEB Strategy Phase One, a BEB operates on the route for the majority of the day, supplemented by a diesel bus during a specific charging period. Figure 5-3 shows a visual comparison of the battery depletion and recharging cycle for the BEB alongside the fuel consumption of the diesel bus.

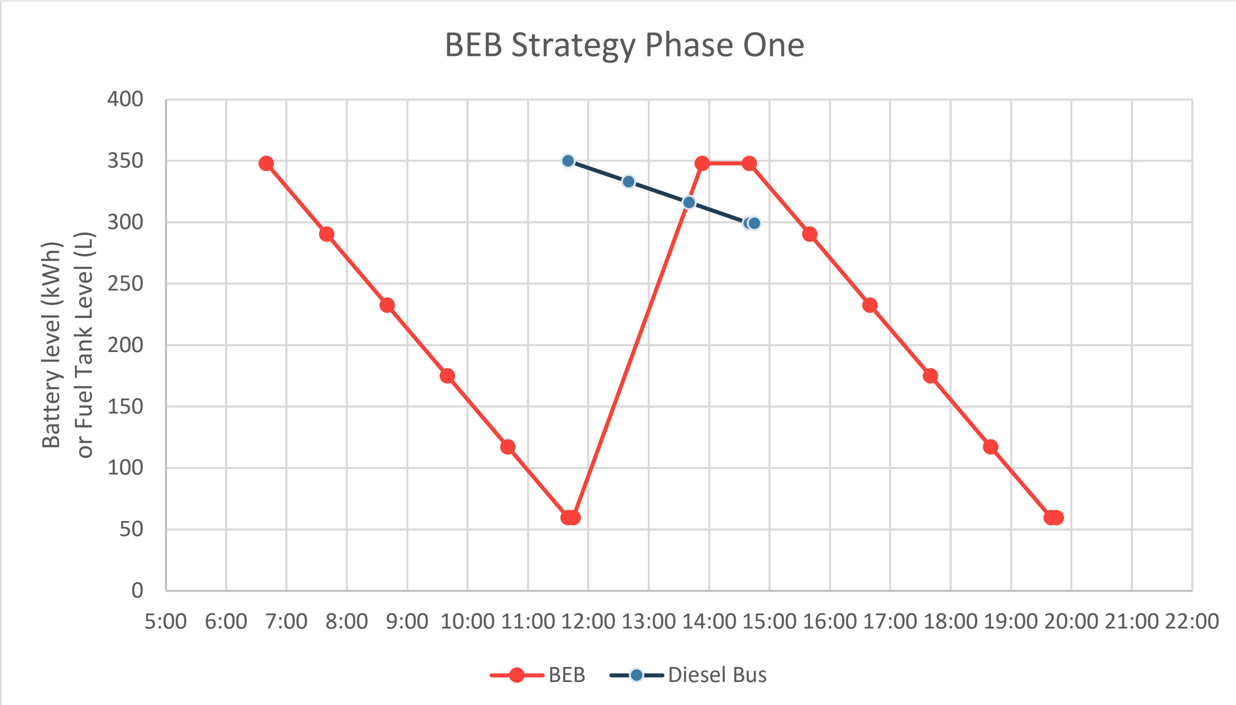

Figure 5-3: BEB Strategy Battery and Diesel Fuel Levels in Phase One

As shown in Table 5-2 the BEB designated as Bus A begins its service at 6:35 AM and operates until 11:40 AM, at which point it returns to the depot for recharging. During this charging period, which lasts approximately 3 hours, a diesel bus (Bus B) steps in to provide service. Bus B completes two round trips on the route while Bus A is charging. At 3:40 PM, Bus A returns to the route and continues its service until 7:45 PM, completing the day's operations. This phase reflects a hybrid approach to accommodate the charging needs of the BEB while maintaining continuous service with the diesel bus backup. Note that while a three-hour midday charge is shown to comfortably work in this strategy, real time experience may demonstrate that this period can be shortened to two hours.

Table 5-2: Service Table for BEB Strategy Phase One

Trip Sequence / Type	Start Time	End Time	Bus	Battery SoC (kWh) / Fuel Level (L)
Pull-out	6:35	6:40	**Bus A (BEB)**	348
1	6:40	7:40	**Bus A (BEB)**	290
2	7:40	8:40	**Bus A (BEB)**	233
3	8:40	9:40	**Bus A (BEB)**	175
4	9:40	10:40	**Bus A (BEB)**	117
5	10:40	11:40	**Bus A (BEB)**	60
Pull-out	11:35	11:40	**Bus B (Diesel)**	350

6	11:40	12:40	**Bus B (Diesel)**	333
Pull-in	11:40	11:45	**Bus A (BEB)**	60
Charging	11:45	13:53	**Bus A (BEB)**	348
7	12:40	13:40	**Bus B (Diesel)**	316
8	13:40	14:40	**Bus B (Diesel)**	299
Pull-out	14:35	14:40	**Bus A (BEB)**	348
9	14:40	15:40	**Bus A (BEB)**	290
Pull-in	14:40	14:45	**Bus B (Diesel)**	299
10	15:40	16:40	**Bus A (BEB)**	233
11	16:40	17:40	**Bus A (BEB)**	175
12	17:40	18:40	**Bus A (BEB)**	117
13	18:40	19:40	**Bus A (BEB)**	60
Pull-in	19:40	19:45	**Bus A (BEB)**	60

5.4.2 STRATEGY 2: BEB STRATEGY PHASE TWO

In BEB Strategy Phase Two, two BEBs operate alternately on the route to optimize energy usage and reduce downtime. The alternating operation allows both buses to rest and charge more frequently throughout the day, ensuring that each bus has sufficient battery levels to complete its full service without any energy shortages.

Figure 5-4 provides a visual representation of the battery depletion and recharging cycles for both BEBs during the day. The graph shows alternating patterns of decreasing SoC when each BEB is in service, followed by an increase in battery levels during their respective charging periods at the depot. By the end of the day, both BEBs successfully complete their service without encountering battery depletion.

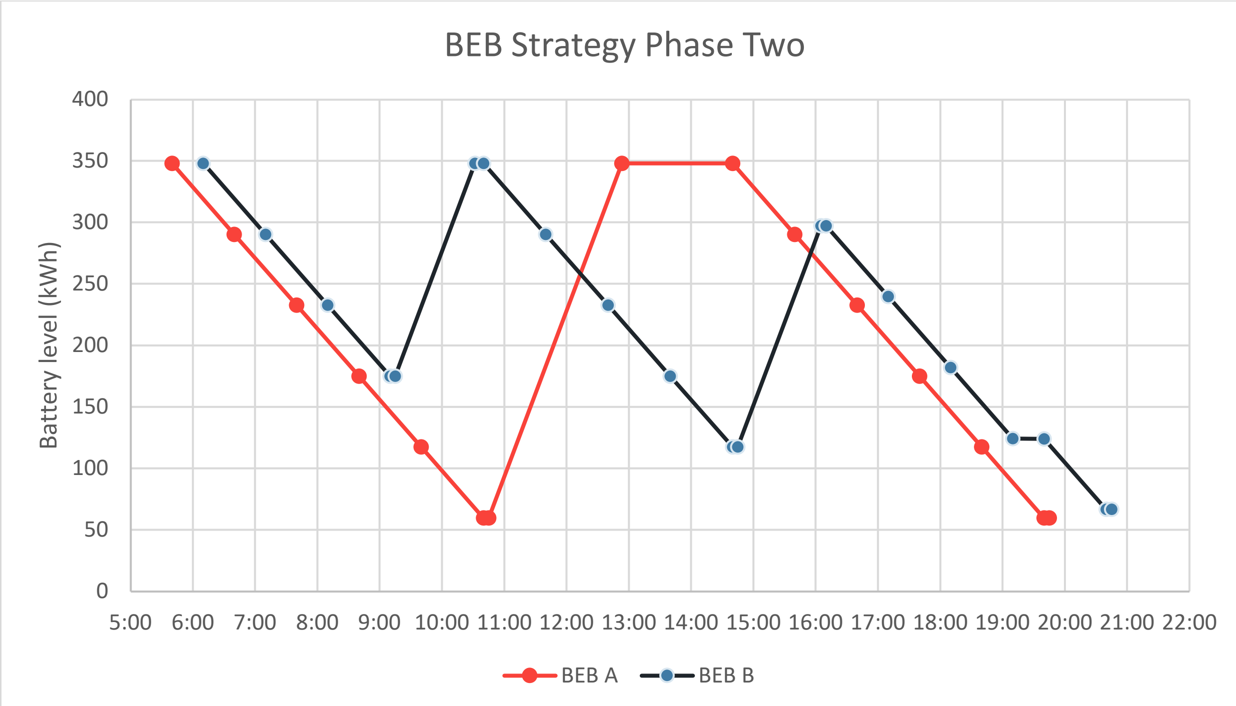

Figure 5-4: Battery Cycles for BEB Strategy Phase Two

Table 5-3 displays the detailed timetable for each BEB, including the times for pulling in and out of service, charging sessions, and revenue trips. The table also records the SoC (State of Charge) at the end of each trip, demonstrating how each bus maintains sufficient battery levels throughout the day, ensuring uninterrupted service and efficient energy use.

Table 5-3: Service Table for BEB Strategy Phase Two

Trip Sequence / Type	Start Time	End Time	Bus	Battery SoC (kWh) / Fuel Level (L)
Pull-out	5:35	5:40	**Bus A**	348
1	5:40	6:40	**Bus A**	290
Pull-out	6:05	6:10	**Bus B**	348
2	6:10	7:10	**Bus B**	290
3	6:40	7:40	**Bus A**	233
4	7:10	8:10	**Bus B**	233
5	7:40	8:40	**Bus A**	175
6	8:10	9:10	**Bus B**	175
7	8:40	9:40	**Bus A**	117

Pull-in	9:10	9:15	**Bus B**	175
Charging	9:15	10:31	**Bus B**	348
8	9:40	10:40	**Bus A**	60
Pull-out	10:35	10:40	**Bus B**	348
Pull-in	10:40	10:45	**Bus A**	60
9	10:40	11:40	**Bus B**	290
Charging	10:45	12:53	**Bus A**	348
10	11:40	12:40	**Bus B**	233
11	12:40	13:40	**Bus B**	175
12	13:40	14:40	**Bus B**	117
Pull-out	14:35	14:40	**Bus A**	348
Pull-in	14:40	14:45	**Bus B**	117
13	14:40	15:40	**Bus A**	290
Charging	14:45	16:05	**Bus B**	297
14	15:40	16:40	**Bus A**	233
Pull-out	16:05	16:10	**Bus B**	297
15	16:10	17:10	**Bus B**	240
16	16:40	17:40	**Bus A**	175
17	17:10	18:10	**Bus B**	182
18	17:40	18:40	**Bus A**	117
19	18:10	19:10	**Bus B**	124
20	18:40	19:40	**Bus A**	60
Pull-in	19:10	19:15	**Bus B**	124
Charging	19:15	19:35	**Bus B**	169
Pull-out	19:35	19:40	**Bus B**	169
21	19:40	20:40	**Bus B**	112

Pull-in	19:40	19:45	**Bus A**	60
Pull-in	20:40	20:45	**Bus B**	112

5.4.3 DIESEL STRATEGY PHASE ONE

In Diesel Strategy Phase One, one 40-ft diesel bus operates on the route for the whole day. Figure 5-5 provides a visual comparison of the fuel consumption of the diesel bus. It shows that a 40-ft diesel bus can complete the whole service without needing to refill the tank if it starts with a tank with 350 L of diesel fuel.

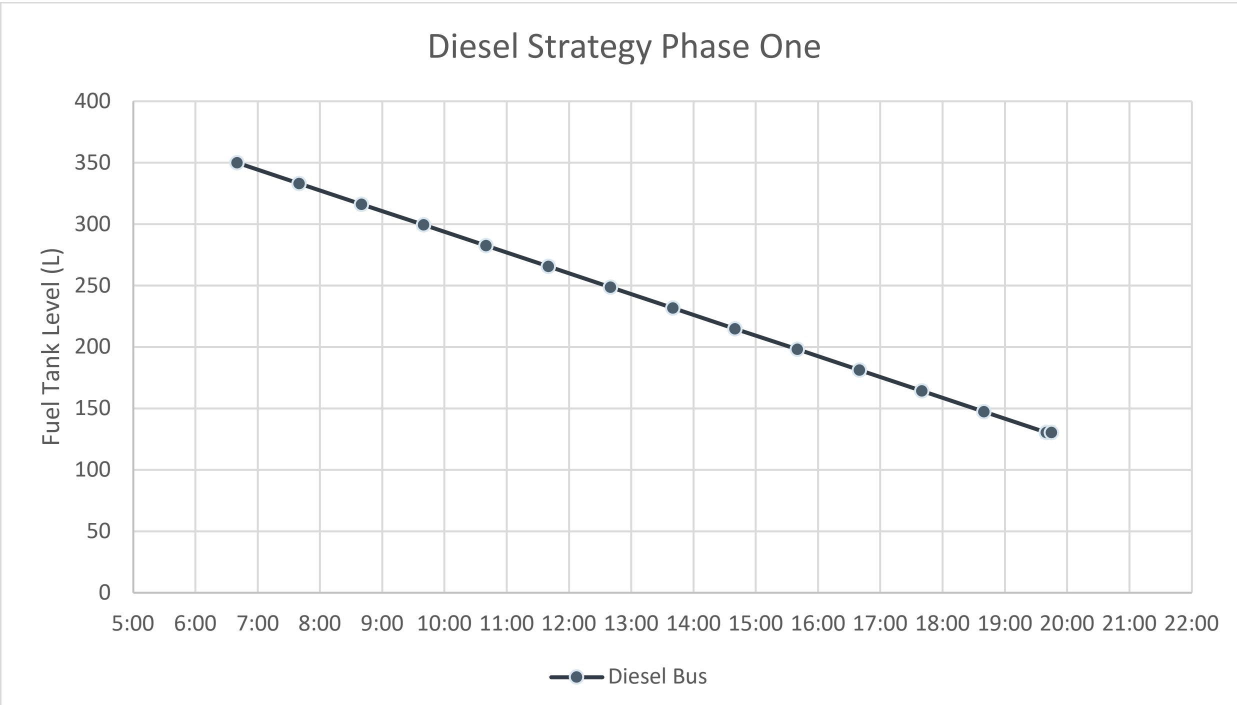

Figure 5-5: Diesel Fuel Consumption for Diesel Strategy Phase One

As shown in Table 5-4 the diesel bus, designated as Bus A, begins its service at 6:35 AM and operates until 7:45 PM, at which point it returns to the depot for storing overnight. It will go through regular checks, refilling the tank and maintenance procedures at Sportsplex.

Table 5-4: Service Table for Diesel Strategy Phase One

Trip Sequence / Type	Start Time	End Time	Bus	Fuel Level (L)
Pull-out	6:35	6:40	**Bus A**	350
1	6:40	7:40	**Bus A**	333
2	7:40	8:40	**Bus A**	316
3	8:40	9:40	**Bus A**	299
4	9:40	10:40	**Bus A**	282
5	10:40	11:40	**Bus A**	266
6	11:40	12:40	**Bus A**	249
7	12:40	13:40	**Bus A**	232
8	13:40	14:40	**Bus A**	215
9	14:40	15:40	**Bus A**	198
10	15:40	16:40	**Bus A**	181
11	16:40	17:40	**Bus A**	164
12	17:40	18:40	**Bus A**	147
13	18:40	19:40	**Bus A**	130
Pull-in	19:40	19:45	**Bus A**	130

5.4.4 DIESEL STRATEGY PHASE TWO

In Diesel Strategy Phase Two, two 40-ft diesel buses operate on the route with double the service frequency during peak hours of the day. Figure 5-6 provides a visual representation of the fuel level change for a day. The graph shows that Bus A runs from early morning to the evening without break in the middle while Bus B only operates during peak hours of the day. By the end of the day, both diesel buses can successfully complete their service without refilling the tank.

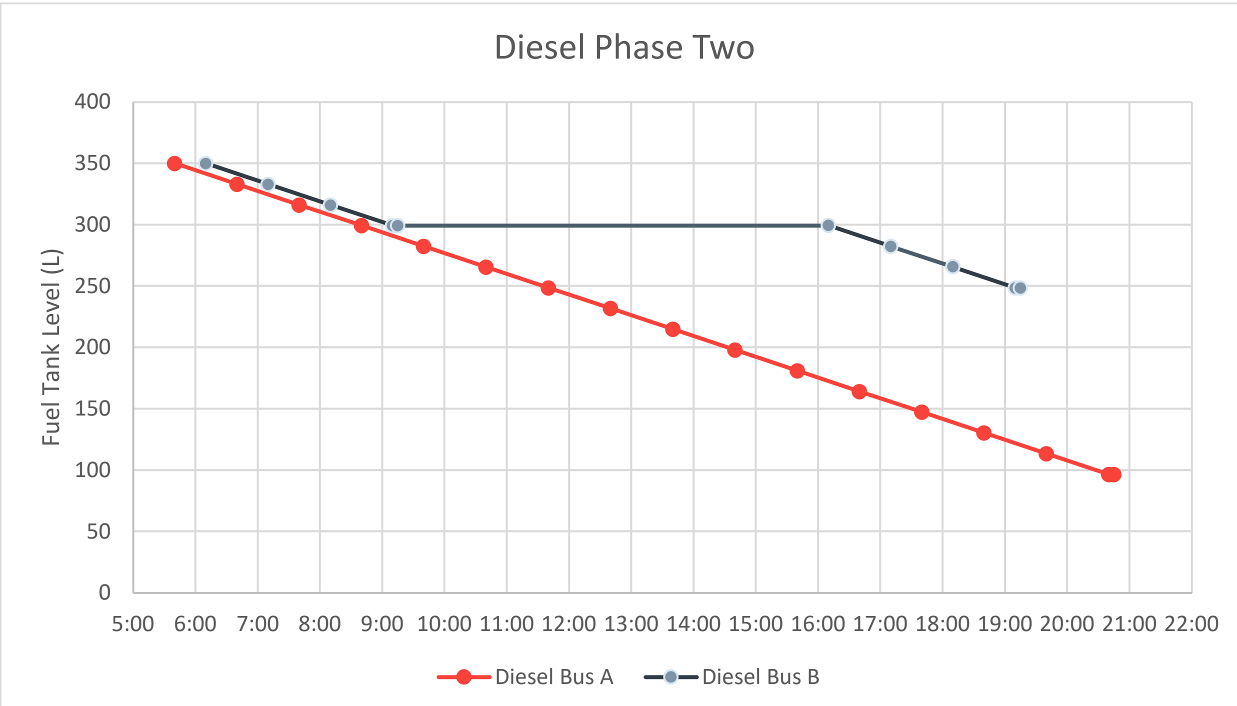

Figure 5-6: Diesel Fuel Consumption for Diesel Strategy Phase Two

Table 5-5 displays the detailed timetable for each diesel bus, including the times for pulling in and out of service, and revenue trips. The table also records the fuel level at the end of each trip, demonstrating how each bus maintains sufficient diesel fuel levels throughout the day, ensuring uninterrupted service.

Table 5-5: Service Table for Diesel Strategy Phase Two

Trip Sequence / Type	Start Time	End Time	Bus	Fuel Level (L)
Pull-out	5:35	5:40	**Bus A**	350
1	5:40	6:40	**Bus A**	333
Pull-out	6:05	6:10	**Bus B**	350
2	6:10	7:10	**Bus B**	333

3	6:40	7:40	**Bus A**	316
4	7:10	8:10	**Bus B**	316
5	7:40	8:40	**Bus A**	299
6	8:10	9:10	**Bus B**	299
7	8:40	9:40	**Bus A**	282
Pull-in	9:10	9:15	**Bus B**	299
8	9:40	10:40	**Bus A**	266
9	10:40	11:40	**Bus A**	249
10	11:40	12:40	**Bus A**	232
11	12:40	13:40	**Bus A**	215
12	13:40	14:40	**Bus A**	198
13	14:40	15:40	**Bus A**	181
14	15:40	16:40	**Bus A**	164
Pull-out	16:05	16:10	**Bus B**	299
15	16:10	17:10	**Bus B**	282
16	16:40	17:40	**Bus A**	147
17	17:10	18:10	**Bus B**	266
18	17:40	18:40	**Bus A**	130
19	18:10	19:10	**Bus B**	249
20	18:40	19:40	**Bus A**	114
Pull-in	19:10	19:15	**Bus B**	249
21	19:40	20:40	**Bus A**	97
Pull-in	20:40	20:45	**Bus A**	97

6 LIFECYCLE ANALYSIS OF STRATEGIES

6.1 INPUTS AND ASSUMPTIONS

The lifecycle comparison will compare fuel/electricity cost and greenhouse gas (GHG) emissions over a 12-year lifespan of the buses. In this comparison, 40ft diesel buses will be compared with 35ft BEBs. The service schedule of 18 round trips is used for analysis which includes double frequency during peak hours. Table 6-1 lists the inputs and assumptions used for lifecycle comparison.

Table 6-1: Inputs and Assumptions Used for Lifecycle Comparison

	Item	Unit	Value
Phase One Mileage	Total daily mileage	km	536
	Annual operation days	#	256
	Total annual mileage	km	137,113.6
Phase Two Mileage	Total daily mileage	km	865.2
	Annual operation days	#	256
	Total annual mileage	km	221,491.2
Efficiency	Annual battery efficiency degradation rate	%/y	1.5
	Average consumption rate (new 35ft BEB)	kWh/km	1.19
	Average fuel economy (40ft diesel bus)	L/km	0.41
Charger	Charger efficiency	%	90
	35ft BEB depot charger power	kW	150
Electricity Rates[3] (small industrial)	0 to 200*(peak demand value)	$/kWh	0.1405
	> 200*(peak demand value)	$/kWh	0.11476
	Demand charge	$/kW	8.332
Others	Diesel price	$/L	1.77
	BEB maintenance cost factor[4]	%	55.9
	Annual inflation rate	%	2.5
	Nova Scotia sales tax	%	15
	Preparation time for pull-out and pull-in trips (check vehicle, washroom break, etc.)	min	5

[3] Electricity rates are from 2024 Small Industrial Tariff from Nova Scotia Power.
[4] The BEB maintenance cost factor is the percentage of diesel maintenance cost that is from source: Battery-Electric Buses piloted in Seattle reduced maintenance costs per mile by 44.1 percent compared to their diesel bus counterparts.

The annual operation days are 256 based on the planned schedule that only runs on weekdays. Since the depot is located at the starting and ending point of each trip, there are no pull-out or pull-in kilometres. The total annual mileage is calculated by the following equation:

$$Phase\ One:$$
$$Round\ trip\ dist \times No.of\ round\ trips \times \#\ of\ days\ in\ a\ year = 41.2km \times 13 \times 256 \approx 137{,}113.6km$$

$$Phase\ Two:$$
$$Round\ trip\ dist \times No.of\ round\ trips \times \#\ of\ days\ in\ a\ year = 41.2km \times 21 \times 256 \approx 221{,}491.2km$$

For BEB Strategy Phase One, the BEB is scheduled to take 10 round trips daily, while a diesel bus will take three round trips in the middle of the day to allow the BEB sufficient time to charge for afternoon service. In this strategy, the daily mileage for the BEBis 10*41.2 km, *i.e.*, 412 km and the daily mileage for the diesel bus in BEB Strategy Phase One is 3*41.2 km, *i.e.*, 124 km.

Since the lifecycle comparison covers long periods, it is appropriate to use the average energy efficiencies for BEBs and average fuel economy for diesel buses, based on testing results from the Altoona test centre.

As batteries age, their efficiency declines, whereas the efficiency of diesel power train remains relatively stable over the lifespan, provided proper maintenance is performed. Thus, no efficiency degradation is considered for diesel buses[5].

6.2 OPERATIONAL COST (OPEX)

The operational cost over the lifecycle of buses consists of two main components: maintenance cost and fuel/electricity cost. For maintenance cost, any major/overhaul repairs are excluded from the analysis. In the calculation of electricity cost, it is assumed that the peak demand is the charger's power. Also, each depot charger can have several dispensers and if more than one BEBs are connected to the charger, the maximum output power remains the same, i.e., 150kW for 35ft BEBs. It is assumed that the diesel price $1.77/L already includes tax. Table 6-2 shows the electricity calculation for the first year which shows the breakdown of the electricity bill.

Table 6-2: Example of Monthly Electricity Cost Calculation (BEB Strategy Phase Two)

	Unit	35ft BEBs
Annual electricity usage	kWh/y	292,861
Monthly electricity usage	kWh/m	24,405
Monthly peak demand	kW	150
Volume charge divider, i.e., 200*peak demand	kWh	30,000
Monthly first part kWh charge (incl. tax)	$	3,429
Monthly second part kWh charge (incl. tax)	$	0
Monthly demand charge (incl. tax)	$	1,250
Total monthly electricity charge	$	5,380.85

[5] Fuel Economy Myths and Misconceptions. U.S. Department of Energy.

Table 6-3 shows the BEB efficiency change over time due to battery degradation, assuming no loss in battery capacity. By year 12, the energy usage is projected to increase by nearly 18%. Figure 6-1 shows the daily battery level variations at the end of 12-year service. Despite the 18% rise in energy usage, both strategies indicate that 35ft BEBs can still complete their daily service.

Table 6-3: BEBs Energy Efficiency Change Over Time

	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
35ft BEB efficiency (kWh/km)	1.19	1.21	1.23	1.24	1.26	1.28	1.30	1.32	1.34	1.36	1.38	1.40

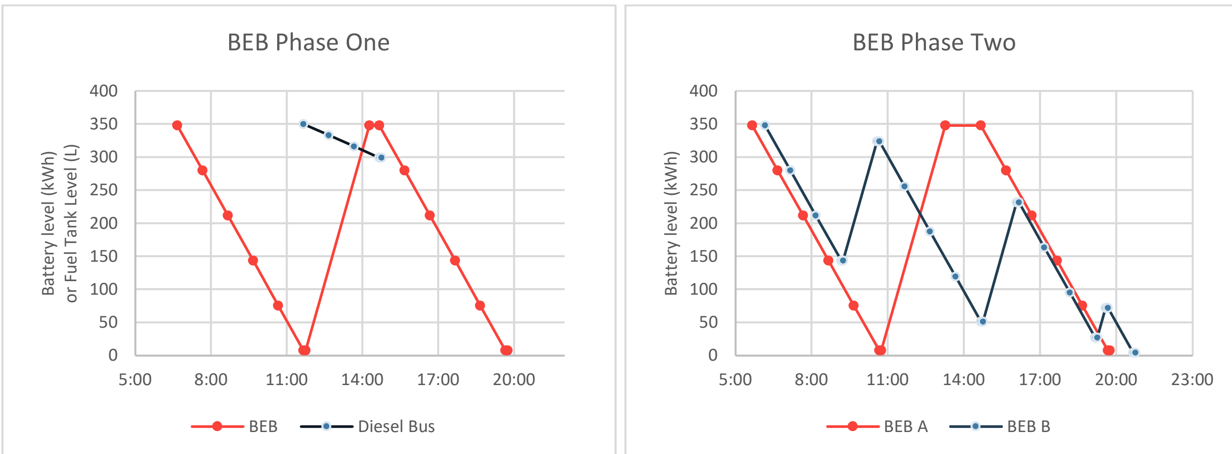

Figure 6-1: Energy Usage for BEBs at the End of 12-year Service

Table 6-4 shows the annual fuel/electricity cost for all strategies. It is notable that to see that BEB Strategy Phase One costs almost as much as BEB Strategy Phase Two, despite Phase Two handling eight extra round trips per day. In addition, Diesel Strategy Phase Two incurs more than double the fuel cost compared to BEB Strategy Phase Two. This highlights the significant energy cost savings potential of BEBs. An annual inflation rate of 2.5% is included.

Table 6-4: Total Annual Fuel/Electricity Cost for All Scenarios

Annual cost ($)	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	Total
BEB Phase One (Total)	**62,800**	**64,600**	**66,600**	**68,600**	**70,800**	**73,000**	**75,200**	**77,500**	**79,900**	**82,400**	**85,000**	**87,600**	**894,00**
BEB	39,800	41,100	42,500	43,900	45,400	47,000	48,600	50,200	51,900	53,700	55,600	57,500	577,200
Diesel Bus	23,000	23,500	24,100	24,700	25,400	26,000	26,600	27,300	28,000	28,700	29,400	30,100	316,800
BEB Phase Two	**64,600**	**66,900**	**69,300**	**71,900**	**74,500**	**77,200**	**80,000**	**82,900**	**86,000**	**89,100**	**92,400**	**95,800**	**950,600**
Diesel Phase One	**99,500**	**102,000**	**104,600**	**107,200**	**109,900**	**112,600**	**115,400**	**118,300**	**121,300**	**124,300**	**127,400**	**130,600**	**1,373,100**
Diesel Phase Two	**160,700**	**164,700**	**168,800**	**173,000**	**177,300**	**181,700**	**186,200**	**190,900**	**195,700**	**200,600**	**205,600**	**210,700**	**2,215,900**

Table 6-5 presents the maintenance cost per kilometre, derived from a study by the National Renewable Energy Laboratory (NREL) in the U.S.[6]. The cost values have been converted to CAD using 1.37 conversion rate from USD. The study provided average maintenance cost for diesel buses at year 2 and 12. The study provided average maintenance costs for diesel buses at years 2 and 12, with a linear progression assumed for the years in between. This linear relationship is depicted in Figure 6-2. For vehicles less than two years old, it is assumed that their maintenance costs are the same as those for two-year-old vehicles. The maintenance cost for BEBs is calculated using the BEB maintenance cost factor shown in Table 6-5. It's important to note that actual maintenance costs could be higher in Canada due to harsher operating conditions, particularly during winter months.

Table 6-5: Maintenance Cost on a Per Kilometre Basis ($/km) Used for Analysis

Annual cost	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Age	1	2	3	4	5	6	7	8	9	10	11	12
Diesel bus maintenance cost	0.32	0.32	0.43	0.55	0.66	0.78	0.89	1.01	1.13	1.24	1.36	1.47
BEB maintenance cost	0.18	0.18	0.24	0.31	0.37	0.44	0.50	0.56	0.63	0.69	0.76	0.82

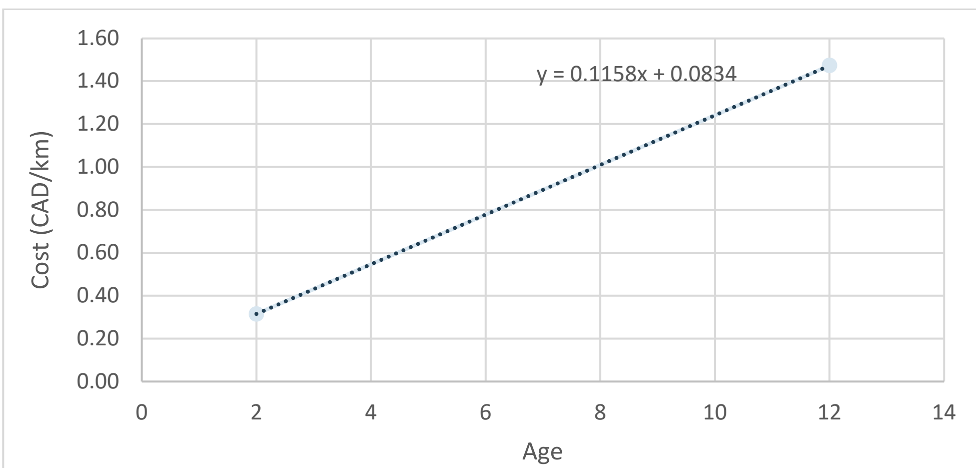

Figure 6-2: Relationship Between Maintenance Cost and Vehicle Age

Table 6-6 presents the annual maintenance costs over a 12-year period for all bus operation strategies. The table highlights how maintenance expenses evolve as the buses age, showing a trend of increasing costs. As expected, newer buses have lower maintenance expenses, but these costs rise significantly over time, especially as the buses near the end of their 12-year life cycle. The table allows for a clear comparison of how the maintenance burden grows year by year across different types of buses, emphasizing that older buses require more frequent and costly maintenance interventions compared to newer models. A 2.5% annual inflation rate is included in the calculations.

[6] Financial Analysis of Battery Electric Transit Buses, NREL.

Table 6-6: Total Annual Maintenance Cost for All Strategies

Annual cost ($)	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	Total
BEB Phase One (Total)	**28,600**	**29,200**	**41,000**	**53,300**	**66,200**	**79,800**	**93,900**	**108,800**	**124,200**	**140,500**	**157,400**	**175,200**	**1,098,100**
BEB	18,600	19,000	26,700	34,700	43,100	51,900	61,100	70,800	80,800	91,400	102,400	114,000	714,500
Diesel Bus	10,000	10,200	14,300	18,600	23,100	27,900	32,800	38,000	43,400	49,100	55,000	61,200	383,600
BEB Phase Two	**39,000**	**40,000**	**56,000**	**72,900**	**90,500**	**109,000**	**128,300**	**148,600**	**169,800**	**192,000**	**215,100**	**239,300**	**1,500,500**
Diesel Phase One	**43,200**	**44,300**	**62,100**	**80,700**	**100,300**	**120,700**	**142,200**	**164,600**	**188,000**	**212,600**	**238,200**	**265,000**	**1,661,900**
Diesel Phase Two	**69,800**	**71,500**	**100,200**	**130,400**	**161,900**	**195,000**	**229,600**	**265,900**	**303,800**	**343,400**	**384,800**	**428,100**	**2,684,400**

Figure 6-3 visually compares the total operational costs, which include both maintenance and fuel/electricity costs, for four different strategies, specifically BEBs and diesel buses. The figure demonstrates that the total cost of operating BEBs is significantly lower than that of diesel buses. While fuel or electricity costs show a gradual increase over the years, influenced by inflation, the maintenance costs rise at a much faster rate. For new buses, fuel or electricity costs are initially higher than maintenance costs. However, by the end of the 12-year period, maintenance costs become more than double those of fuel/electricity costs.

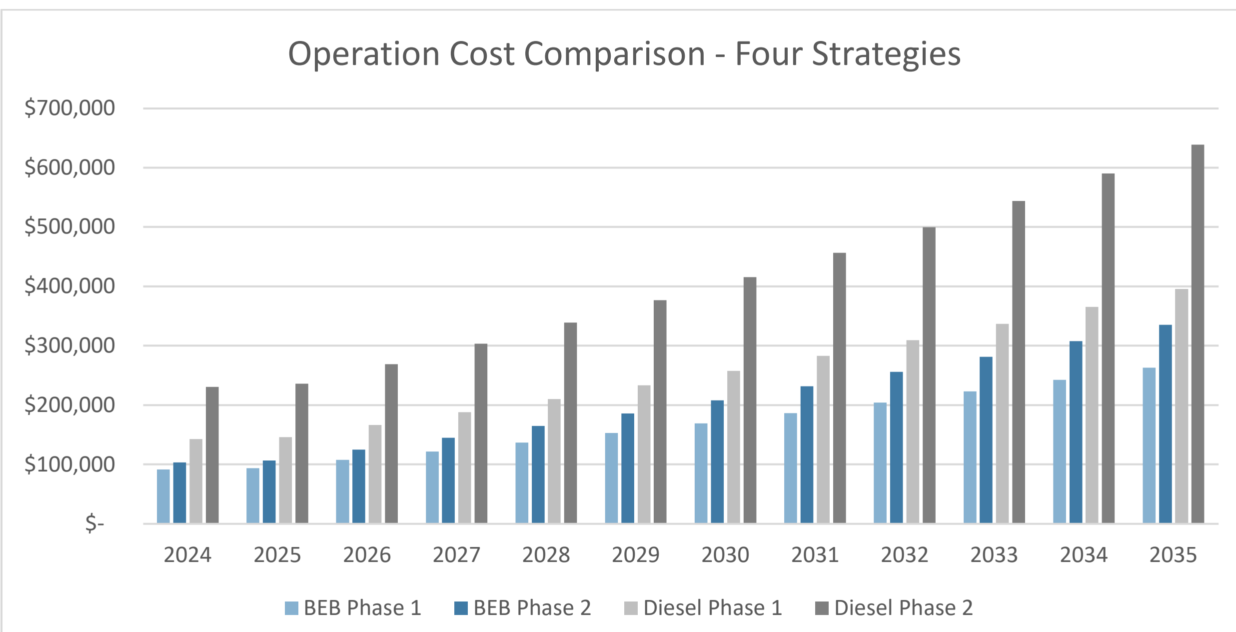

Figure 6-3: Operational Cost Comparison for All Strategies

6.3 GREENHOUSE GAS (GHG) EMISSIONS

Although Battery Electric Buses (BEBs) do not emit greenhouse gases during operation, the generation of electricity does produce some emissions. Nova Scotia Power has published data on GHG emissions from electricity generation, which is shown in Figure 6-4. Since the historical data, spanning from 2005 to 2023, follows a clear linear trend, linear regression is used to project emissions through to 2035. A significant reduction in emissions was observed in 2023 compared to 2022, and if this trend continues, future emissions could be even lower than current predictions.

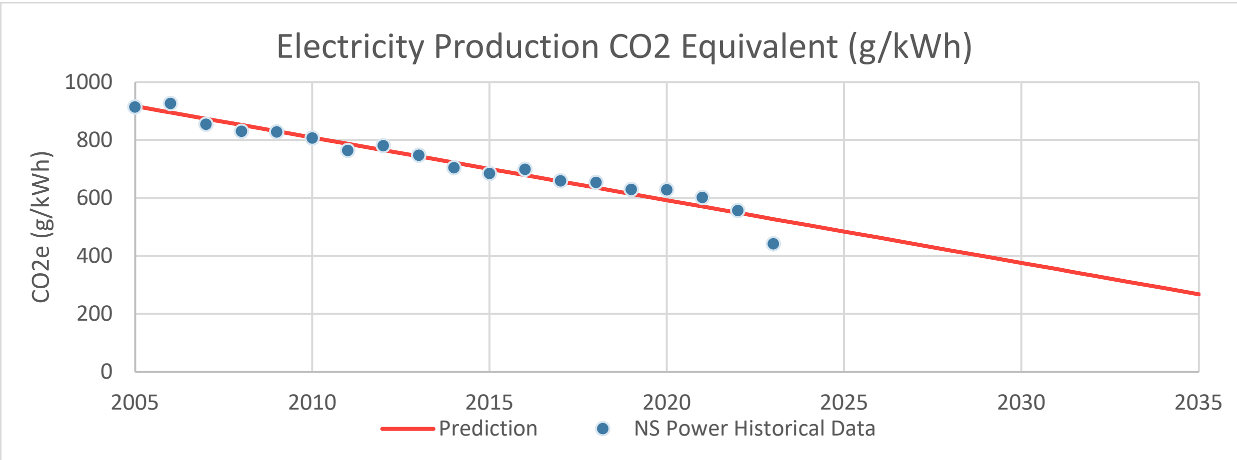

Figure 6-4: Historical Records and Predictions of GHG Emissions from Electricity Generation in Nova Scotia.

For diesel buses, GHG emissions are calculated based on the combustion of diesel fuel, assuming no renewable components are blended into the fuel. The emissions associated with the production of diesel fuel are not considered in this calculation. Table 6-7 presents the GHG emission factor for diesel fuel, indicating that burning 1 litre of diesel generates approximately 2,689 grams of CO_2 equivalent.

Table 6-7: Diesel Fuel GHG Emissions Factors [7,8]

Diesel Emission factor	CO_2	*CH_4	*N_2O	Equivalent CO_2
Diesel (g/L)	2681	0.078	0.022	**2689**

* Note CH_4 and N_2O gases have higher global warming potentials, i.e., 28 and 265 times of CO_2, respectively.

The emission factors from Table 6-7 combined with the CO_2 projections from Figure 6-4 provide annual GHG emissions estimates for the lifecycle of buses in each strategy, as shown in Table 6-8 and Figure 6-5. It is evident that 35-foot BEBs generate significantly lower GHG emissions compared to diesel buses. Additionally, as Nova Scotia's electricity grid continues to become cleaner each year, the GHG emissions from operating BEBs will decrease further, while the emissions from diesel buses are expected to remain relatively constant.

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[7] Emission factors and reference values, Government of Canada

[8] Global warming potentials, Government of Canada.

Table 6-8: Annual GHG Emissions Comparison Between Diesel Buses and BEBs

Annual GHG	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
BEB Phase One (Total)	98.4	95.7	93.0	90.3	87.5	84.8	82.1	79.4	76.7	74.0	71.3	68.5
BEB	63.5	60.8	58.1	55.4	52.7	49.9	47.2	44.5	41.8	39.1	36.4	33.7
Diesel Bus	34.9	34.9	34.9	34.9	34.9	34.9	34.9	34.9	34.9	34.9	34.9	34.9
BEB Phase Two	133.4	127.7	122.0	116.3	110.6	104.9	99.2	93.5	87.8	82.1	76.4	70.7
Diesel Phase One	151.2	151.2	151.2	151.2	151.2	151.2	151.2	151.2	151.2	151.2	151.2	151.2
Diesel Phase Two	244.2	244.2	244.2	244.2	244.2	244.2	244.2	244.2	244.2	244.2	244.2	244.2

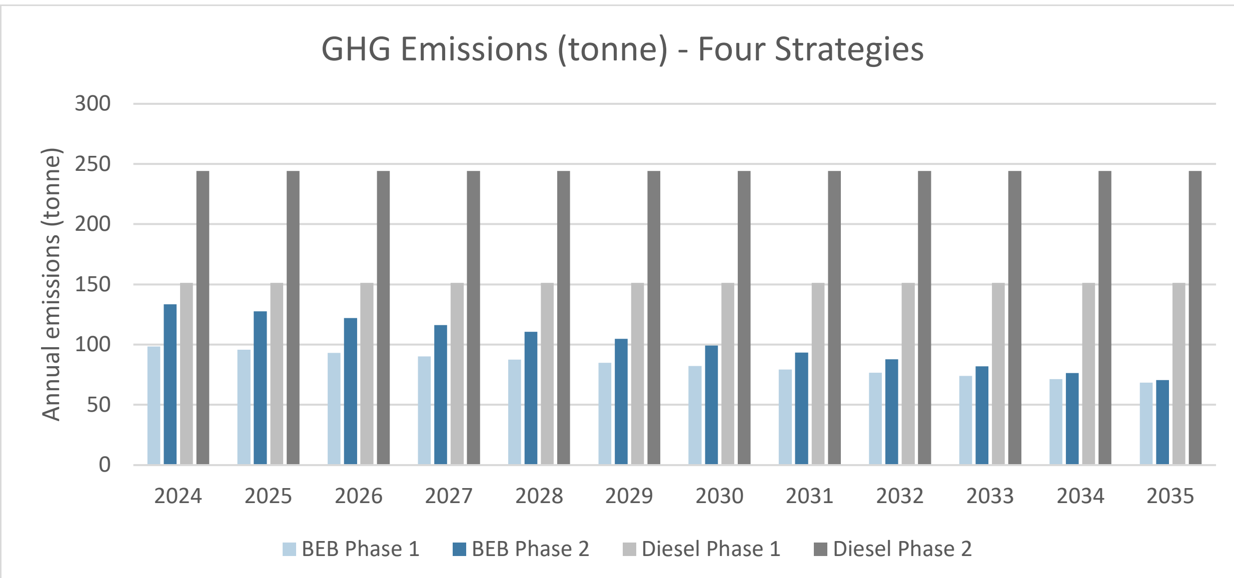


Figure 6-5: Annual GHG Emissions Comparison Between Diesel Buses and BEBs.

6.4 CAPITAL COST

The capital cost calculation includes the cost of vehicles across all strategies. For strategies involving BEBs, the cost of chargers is also considered. Table 6-9 provides a breakdown of the capital costs for each strategy.

For each strategy it is assumed that a used diesel bus is acquired for use as a spare. A figure of $80,000 has been used, although in the past used buses have been acquired from other transit agencies for a highly discounted price. For the BEB Strategy Phase One, a spare is needed only for times when the diesel bus is being service so a rental may be more applicable than a purchase. If a decision is made to contract East Hants Community Rider to operate the service, the cost of a spare bus may be eliminated under the assumption that EHCR can cover this with their existing fleet.

Table 6-9: Capital Cost for All Strategies[9]

	BEB Strategy Phase One	BEB Strategy Phase Two	Diesel Strategy Phase One	Diesel Strategy Phase Two
Diesel vehicle cost[10]	$ 740,000	$ -	$ 740,000	$ 1,480,000
BEB vehicle cost[11]	$ 1,350,000	$ 2,690,000	$ -	$ -
Used Spare Bus	$20,000	$80,000	$80,000	$80,000
Charger cost [12]	$ 170,000	$ 170,000	$ -	$ -
Sum	**$ 2,280,000**	**$ 2,940,000**	**$ 820,000**	**$ 1,560,000**

The capital costs for BEBs are higher than for diesel buses due to the added expense of vehicles and chargers. For instance, BEBs in Phase One cost $2,280,000 compared to $820,000 for diesel buses, and this gap widens in Phase Two. Diesel buses, though cheaper upfront and without charger expenses, will continue to incur fuel-related operational and environmental costs. In contrast, BEBs, despite their higher initial investment, may become more cost-effective over time as Nova Scotia's electricity grid becomes cleaner and operational costs decrease.

[9] The costs are rounded to the nearest 10,000.

[10] WisDOT heavy Duty Bus Price Sheet. https://wisconsindot.gov/Documents/doing-bus/local-gov/astnce-pgms/transit/procurement/hdb-price.xlsx (Conversion rate of USD to CAD is 1:1.37)

[11] WisDOT heavy Duty Bus Price Sheet. https://wisconsindot.gov/Documents/doing-bus/local-gov/astnce-pgms/transit/procurement/hdb-price.xlsx (Conversion rate of USD to CAD is 1:1.37)

[12] Estimated from past projects.

7 ASPECTS OF OPERATION

7.1 TRANSIT STOPS

The 2020 Plan recommended using fixed stops throughout the system and provided a map showing proposed stop locations and route timing points. This 2024 Plan has focused in a little more closely on how stops should be designed and more precisely where to locate them. A detailed stop-by-stop description and routing for both the 2020 Plan and the 2024 Plan is provided in Appendix A.

In general, stop locations are selected based on the following criteria:

- Close to intersections to reduce walking distance from trip origins and destinations along side streets and to encourage crossing the street at intersections
- At locations where there is a marked crosswalk to facilitate crossing the street
- Close to clusters of higher density residential
- Outside of curved roadway sections, crests in the roadway, or other locations where sight distance from approaching vehicles to the stopped bus would be limited
- At locations with a streetlight
- At locations with an adjacent sidewalk or where the existing shoulder area provides a safe opportunity for passengers to wait (i.e. flat and/or wide)
- Avoiding locations in front of residential properties to avoid perceived impact

Transit stops may be located either in-line or off-line. At an in-line stop, buses stop to pick up or drop off passengers in the traffic lane, requiring cars to queue behind them or pass, if permitted, on the left. At an off-line stop, buses pull out of traffic into an exclusive space, typically for buses only. The prevailing approach in the transit industry has been to favour in-line stops and to avoid off-line stops other than at transfer or schedule timing points. An off-line stop requires the bus to pull out of traffic when picking up or dropping off a passenger and then to pull back into traffic, resulting in potential delay (even with Provincial legislation requiring approaching vehicles to yield to the bus). The in-line approach may cause some delay for traffic but helps to emphasize the philosophy of providing priority for transit buses.

For accessibility, the transit buses will have a low-floor design with a deployable front-door ramp for wheelchairs and other mobility aids. For the ramp to work effectively, there should be a concrete pad at the stop for the ramp to rest on. A concrete surface extending to the bus door is also important for those with mobility challenges not requiring a wheelchair.

The approach for designing bus stops will be different (see Figure 7-1) depending on whether the street edge is urban (curb and sidewalk) or rural (shoulder and ditch). For locations where there is a concrete sidewalk in place typically the west side of Trunk 2 and the north side of Route 214, a small pad is required at the location where the bus's front door stops at a minimum. Ideally, this pad would be built with sufficient width (8 metres) so that both front and rear doors (if applicable) are covered. For locations where there is no sidewalk and only a shoulder-and-ditch, parking lot or extended shoulder, typical of the east side of Trunk 2 and the south side of Route 214, a raised concrete pad will be required both for accessibility and for the safety of all clients as they await the arrival of the bus.

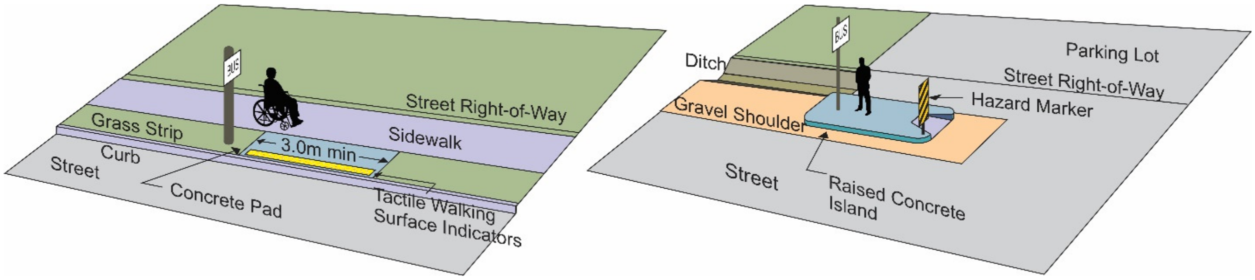


Figure 7-1: Bus Stop Pad in Location with a Sidewalk (Left) and Without a Sidewalk (Right)

While transit shelters provide protection from the weather for clients and can produce advertising revenue opportunities, we suggest that they not be installed for the initial deployment of the service. Some transit agencies in Nova Scotia have had success with businesses and service organizations sponsoring the acquisition and installation of shelters and this may be an opportunity for East Hants as the service matures.

Highly visible signs are an important component of every bus stop. The sign helps potential clients to quickly locate stops and their visibility from the road helps to promote the system. A sign made with retroreflective material and predominantly white with some trim color and custom design is recommended. A design like that used by Yarmouth Transit (Figure 7-2) is a good model. It uses no words, only pictograms, to convey that it's a bus stop and includes the Town logo to customize it. This can be part of a larger system branding plan that also adds colour, trim and logos to the buses to make them distinctive to the East Hants service.

East Hants should adopt a simple transit stop sign design that is highly visible.

Figure 7-2: Example of Bus Stop Sign (Yarmouth)

7.2 INTERCONNECTION WITH OTHER TRANSIT

The 2020 Plan described the interaction between the East Hants service and Halifax Transit at the Airport connection point in terms of fare transfers. Our discussions with Halifax Transit still indicate that this is a possibility but would require a more formal proposal from East Hants closer to implementation.

Interconnection with a future regional public transit service expected to be proposed by the Joint Regional Transportation Agency (JRTA) raises some interesting opportunities for the East Hants service. As proposed by the JRTA, the regional service could be either a rail or bus service.

As a bus service it would run between Truro and Halifax via Halifax Stanfield Airport with stops at strategic locations along the way. The service would operate with about four to six one-way trips per weekday. For East Hants, Exits 7 (Enfield), 8 (Elmsdale) and 8A (Lantz) all provide opportunity for construction of a transfer point and park-and-ride lots. However, since there would be only one location within the East Hants system where the bus timetables could be aligned, we recommend the development of a connection point at Exit 7. This location is preferred as it would result in nobody destined to Halifax having to "backtrack" on the East Hants service to get to the connection point. If the Regional bus were to operate more frequently than once per hour (possibility during peak commuter periods), a second connection point within the East Hants service could be developed.

The train service would operate similarly to the bus service except that a direct connection to Halifax Stanfield Airport could not be provided. The best opportunity for connection points between the East Hants bus service and the Regional train service would be Station Road at Trunk 2 or the Route 214/Trunk 2 intersection. Since the Regional train will not connect to the Airport, a transfer point at Station Road may be a better strategic choice. That would allow passengers from the Regional train service to transfer to the East Hants bus service as a means of reaching the Airport.

A regional bus service to Halifax Stanfield Airport with connectivity to the East Hants service opens some opportunities to consider. Rather than running buses past Enfield to the Airport, East Hants could terminate its service at the Enfield Big Stop and require passengers bound for the Airport to transfer to the Regional service. While this approach would provide some extra time (12-13 minutes) that the East Hants bus could be deployed elsewhere to extend service coverage within East Hants, it would also decrease accessibility to the airport as that connection would be provided only the 4-6 times that the Regional bus operates.

East Hants should work with the Joint Regional Transportation Agency as plans are developed for the Highway 102 transit corridor to ensure it connects well with the East Hants service and makes use of it for rail-to-airport connections.

7.3 FARE COLLECTION TECHNOLOGIES

In all aspects of society, it is becoming more and more evident that using cash for payment is becoming less and less preferred. The expectation that payment options other than cash will be provided is clearly prevalent.

Late in 2023, Halifax Transit rolled out the HFXGO phone app. Through the app, clients purchase tickets or a monthly pass. When they wish to board a bus or ferry, they activate one of their tickets or their monthly pass. This creates a QR code image on their phone which is scanned and validated by an on-board scanner.

HotSpot is a phone app that has gained widespread use throughout Atlantic Canada to pay for parking. This app also has a feature to pay for a single transit trip. The user activates a virtual "ticket" as the bus arrives and shows it to the driver for manual validation. The image is animated to ensure that a live activation is being used and not a screenshot. The cost of the ticket is deducted from the user's account and HotSpot reimburses the transit agency for fares collected monthly. Bridgewater Transit offers HotSpot payment for fares although they report that it has not been widely adopted by users.

It is also possible for a transit agency to accept credit and debit cards for fare payment using an onboard remote hand-held card reader. Transaction fees, signal reliability and adding to boarding time and driver workload are all considerations with the adoption of this technology. Antigonish Transit currently offers this payment option for passengers.

East Hants should enter into a negotiation with Halifax Transit for shared use of their fare collection technology and the HFXGO phone app.

7.4 VEHICLE TRACKING APP

Like electronic payment, having real-time information on bus location is becoming an expectation in a society that is becoming more and more tech-savvy. Although some third-party transit tracking apps will include larger transit services (like Halifax Transit) in their product offering, smaller services are less likely to be included. Real-time bus tracking apps have been shown to increase client's confidence in the transit system particularly buses are delayed and get off-schedule. Bridgewater Transit (see Figure 7-3) has worked with a local technology company to develop their own real-time app which requires the bus to simply have a connected mobility device onboard.

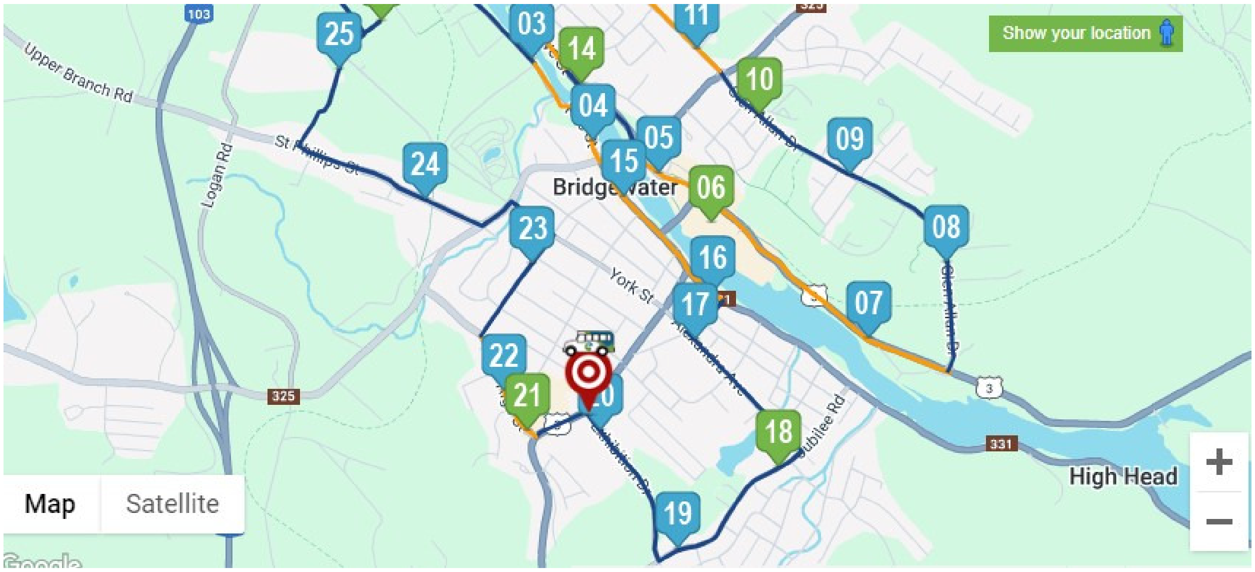


Figure 7-3: Screenshot of Bridgewater Transit Bus Tracking App

East Hants should request a price quotation from the developer of the Bridgewater Transit Tracker (Digital Fusion Inc.) for implementation of a similar product for East Hants Transit.

8 ASPECTS OF OPERATING MODELS

8.1 STAFFING

From our observation of other smaller-sized services, we believe that administration of the transit service will require six-tenths of an FTE (full time equivalent) position for general administrative tasks and one-tenth of an FTE for higher level management and oversight.

If the Municipality were to operate the service, the one-tenth of a position might best be worked into an existing managerial position. The six-tenths of a position could be filled either by hiring a staff person part-time specifically for the transit assignment (as Bridgewater Transit and Yarmouth Transit have), reallocating responsibilities for an existing position to include transit, or creating a new position which includes new responsibilities elsewhere within the Municipality's organizational structure including transit.

For EHCR, the higher-level management task would be added on top of the existing workload of the Executive Director. For the operational level task, EHCR would have the same options as the County, however the most likely outcome would be to hire a new full-time staff person who in addition to the responsibilities with the fixed route system could also take on dispatching and/or driving tasks.

If EHCR were to be contracted to operate the service, the Municipality would still need to appoint a staff member to oversee service coordination, although this is expected to involve less than 0.1 FTE.

8.2 FLEET

For the Municipality to operate the transit service, a full-time spare bus would be required that would only be deployed when the in-service bus(es) is out of service.

This is one area where the EHCR has a clear advantage over the Municipality operating the transit service. Having multiple buses available would allow EHCR to provide backup coverage by shifting buses between the fixed-route and on-demand sides of their operation.

One "hybrid" option that might be worth exploring is for an agreement to be negotiated whereby EHCR offers a bus or van from within their fleet to the Municipality as a spare for a short-term rental. This would allow the Municipality to own a single bus, while leasing a bus or van from EHCR for the occasional times that bus is out of service due to scheduled maintenance or breakdown. While scheduling of maintenance to coincide with lower demand periods for EHCR may reduce impact on their operation, unscheduled breakdowns will be difficult to manage without impacting the on-demand service.

Each of the other single-route transit services in Nova Scotia that we surveyed own a spare bus that is dedicated, or substantially dedicated, to the fixed route service. Bridgewater Transit and Yarmouth Transit, in fact, employ two identical buses and alternate them into service on a daily (Bridgewater) or weekly (Yarmouth) basis making the case that this will achieve close to a doubling of the life expectancy of each bus compared to running one of the buses every day.

8.3 INSURANCE

Ensuring the vehicles and ensuring the service from liability would be the responsibility of the organization operating the service. For the Municipality or EHCR, this would be an extension of their current insurance.

8.4 VEHICLE STORAGE AND MAINTENANCE

In our analysis, we have considered two locations for vehicle storage: the East Hants Community Learning Centre and the East Hants Sportsplex. Both locations are on the transit route, but the Sportsplex offers the advantage of eliminating dead-head time as it makes the most logical location for starting and ending the service each day. At both locations, the buses would be stored and charged outside, at least in the short term. The ability of the power grid to support the needed charging infrastructure would need to be determined. We will assume that a selection of a charging and overnight storage location can be made independent of which body is operating the service as both would be on Municipally owned property.

Although two local garages were identified in the 2020 Plan as being able to service shuttle-type buses, neither would have the capability of lifting and servicing a 35-foot or 40-foot transit bus. The best option for servicing these larger vehicles may be to negotiate an arrangement with a private-sector bus operator (Ambassatours or Coach Atlantic) or a public-sector bus operator (Halifax Transit or Kings Transit).

8.5 DRIVER SHIFTS

One strategy for creating driver shifts for each of the Phase One and Phase Two scheduling plans is shown in Table 8-1. Drivers start each shift at the Sportsplex. In addition to the time driving the bus, a total of thirty minutes should be included for preparation of the bus at the start of the shift and for cleaning, parking and fueling/charging it at the end of the day.

Although some of the Phase Two shifts are relatively short, our experience from other transit agencies in Nova Scotia is that a number of drivers that retire from urban transit driving are eager for part-time shifts.

Table 8-1: Strategy for Driver Shifts

Depart Sportsplex	
Phase One	Phase Two
	5:40
	6:10
6:40	6:40
	7:10
7:40	7:40
	8:10
8:40	8:40
9:40	9:40
10:40	10:40
11:40	11:40
12:40	12:40
13:40	13:40
14:40	14:40
15:40	15:40
	16:10
16:40	16:40
	17:10
17:40	17:40
	18:10
18:40	18:40
	19:40

Phase One Shifts

Shift 1	7.5 hours
Shift 2	6.5 hours

Phase Two Shifts

Shift 1	4.5 hours
Shift 2	7.0 hours (B)
Shift 3	7.0 hours (B)
Shift 4	5.5 hours

Note: Shifts include 30 minutes prep time

(B) Indicates shifts that include a scheduled 30 minute rest break

8.6 OPERATING LICENSE

Since the East Hants Transit service will travel beyond the jurisdictional boundaries of the Municipality and pick up and drop off passengers at three stops within Halifax Regional Municipality (HRM), an operating license will be required from the Nova Scotia Utility Review Board (NSURB) under the Motor Carrier Act. The key purpose of requiring this license is to ensure that the East Hants service is not viewed as "predatory" by HRM or other transit operators. As part of its review of the license application, the NSURB will consult with HRM and, from our discussions with their staff, we can be confident that no concerns will be raised. Similarly, it is highly unlikely that Maritime Bus will view the service as infringing on the inter-city service they currently operate.

9 FINANCIAL SUMMARY

9.1 OPERATING COSTS

Operating costs for the first year of implementing the BEB Strategy have been summarized for both ongoing annual costs and shown in Table 9-1. Equivalent costs for the Diesel Strategy are shown in Table 9-2. One-time start-up costs, applicable to either strategy, are provided in Table 9-3.

Table 9-1: Ongoing Annual Operating Cost for BEB Strategy (Year One)

Item	Annual Cost BEB Phase One	Annual Cost BEB Phase Two	Assumptions/Notes
Energy	$62,800	$64,600	See Table 6-4
Maintenance	$28,600	$39,000	See Table 6-6
Vehicle Replacement Reserve	$87,000	$112,000	Approximately half the cost of full fleet replacement is included, to be supplemented by grants or debt
Drivers	$125,400	$215,000	$35/hr (incl. benefits); 256 operating days
Administration Salaries	$94,100	$94,100	$70/hr (incl. benefits) for 0.6 and 0.1 FTE
Administration Costs	$8,000	$8,000	Marketing, printing, etc.
Insurance	$12,000	$16,000	
Bus Stop Maintenance	$6,000	$6,000	Primary cost is snow clearing
Vehicle Tracking	$2,000	$2,000	
TOTAL	**$425,900**	**$556,700**	

Note: All costs include 15% HST.

The vehicle replacement reserve is intended to set aside funds to replace the vehicles at end of life which should be no less than twelve years. The reserve is calculated to fund half the replacement of the full fleet under the assumption that the remainder can be recovered through external funding sources or, failing that, payment from debt. The vehicle replacement reserve may also be applied to extending the life of the vehicle through overhaul and/or battery replacement (if applicable). Not all Municipal Governments use reserve funding for this purpose and this item may be removed from the total if deemed appropriate.

The anticipated revenue is shown in and is taken from the 2020 Study and scaled up for the increased service frequency in Phase Two.

Table 9-2: Ongoing Annual Operating Cost for Diesel Strategy (Year One)

Item	Annual Cost Diesel Phase One	Annual Cost Diesel Phase Two	Assumptions/Notes
Energy	$99,500	$160,700	See Table 6-4
Maintenance	$43,200	$69,800	See Table 6-6
Vehicle Replacement Reserve	$45,000	$90,000	Approximately half the cost of full fleet replacement to be supplemented by grants or debt
Drivers	$125,400	$215,000	$35/hr (incl. benefits); 256 operating days
Administration Salaries	$94,100	$94,100	$70/hr (incl. benefits) for 0.6 and 0.1 FTE
Administration Costs	$8,000	$8,000	Marketing, printing, etc.
Insurance	$6,500	$13,000	
Bus Stop Maintenance	$6,000	$6,000	Primary cost is snow clearing
Vehicle Tracking	$2,000	$2,000	
TOTAL	**$429,700**	**$658,600**	

Note: All costs include 15% HST.

Table 9-3: One-Time Start-up Operating Costs

Item	Cost	Assumptions/Notes
Start-up Engineering	$35,000	Vehicle specification, bus stop design, etc.
Bus Stops and Signs	$90,000	
Marketing/Branding	$8,000	
Vehicle Tracking App Setup	$7,000	
TOTAL	**$140,000**	

Note: All costs include 15% HST

9.2 CAPITAL COSTS

Table 9-4: Capital Cost by Strategy

	BEB Strategy Phase One	BEB Strategy Phase Two	Diesel Strategy Phase One	Diesel Strategy Phase Two
Diesel vehicle cost[13]	$ 740,000	$ -	$ 740,000	$ 1,480,000
BEB vehicle cost[14]	$ 1,350,000	$ 2,690,000	$ -	$ -
Used Spare Bus	$20,000	$80,000	$80,000	$80,000
Charger cost [15]	$ 170,000	$ 170,000	$ -	$ -
Sum	**$ 2,280,000**	**$ 2,940,000**	**$ 820,000**	**$ 1,560,000**

9.3 FARES AND REVENUE

The fares shown in Table 9-5 reflect the recommendation from the 2020 Study. They remain in line with fares from other Nova Scotia systems and are still recommended.

Ridership projections and fare revenue were determined in the 2020 Study and also remain valid. If anything, residential density has increased along the proposed route since projections were made in 2020 and densities are higher than along corresponding routes in other jurisdictions. Accordingly, these projections can be viewed as being "conservative". Since Phase Two operation results in a 62% increase in service kilometers, primarily in the commuting peak hours, a corresponding increase in revenue can be expected. Anticipated revenue is shown Table 9-6

Table 9-5: Recommended Fare Structure

Item	Cash Fare	Monthly Pass
Adult	$3.00	$70.00
Senior	$3.00	$50.00
Student/Child	$3.00	$50.00
Child 5 & under	free	free

Table 9-6: Fare Revenue by Phase

	Phase One	Phase Two
Fare Revenue	$47,000	$76,000

[13] WisDOT heavy Duty Bus Price Sheet. https://wisconsindot.gov/Documents/doing-bus/local-gov/astnce-pgms/transit/procurement/hdb-price.xlsx (Conversion rate of USD to CAD is 1:1.37)

[14] WisDOT heavy Duty Bus Price Sheet. https://wisconsindot.gov/Documents/doing-bus/local-gov/astnce-pgms/transit/procurement/hdb-price.xlsx (Conversion rate of USD to CAD is 1:1.37)

[15] Estimated from past projects.

9.4 LIFE-CYCLE FLEET COSTS

Using the expected 12-year life of a transit-style bus, the total present value of fleet costs, including buses, maintenance and charging infrastructure (if applicable), for each of the strategies assessed was determined. The results of that are provided in Figure 9-1. Phase two costs are total costs including phase one purchases.

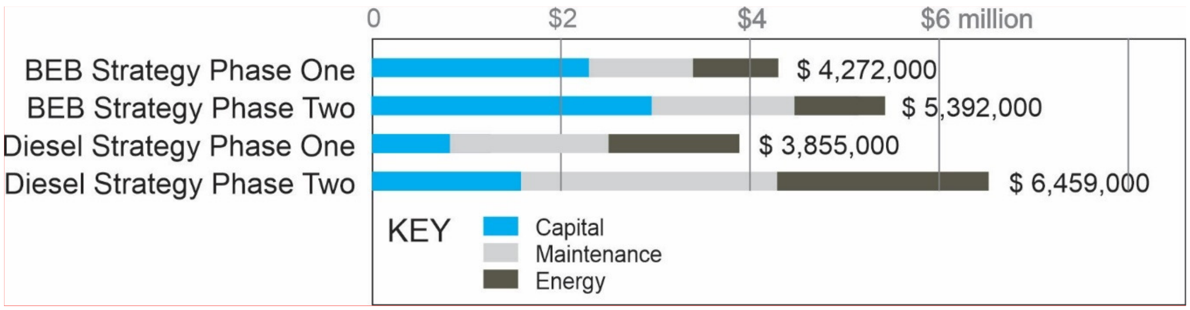


Figure 9-1: 12-Year Life Cycle Costs for Each Strategy

This calculation shows that for the Phase One strategies, using diesel buses costs slightly less than BEB. In part, this is due to the need to include some diesel bus runs in the BEB strategy. For Phase Two operation, however, BEB is the clear winner. In the Phase Two BEB strategy, the two BEB's are being used more optimally and the reduced annual operating cost more than offsets the high capital cost.

Of course, transitioning to the Phase Two BEB strategy must start with selection of the BEB strategy for Phase One. With an expectation that moving to Phase Two operation is likely in the future, it makes sense to invest the additional dollars to adopt the BEB strategy in Phase One.

9.5 PROJECT START-UP COST SUMMARY

The Year One implementation cost for each strategy is shown in Figure 9-2. Clearly the BEB Strategy is more expensive than the Diesel Strategy due to its high initial capital investment but, as this report has demonstrated, this can be more than offset by the reduced annual operating cost over the life of the vehicle.

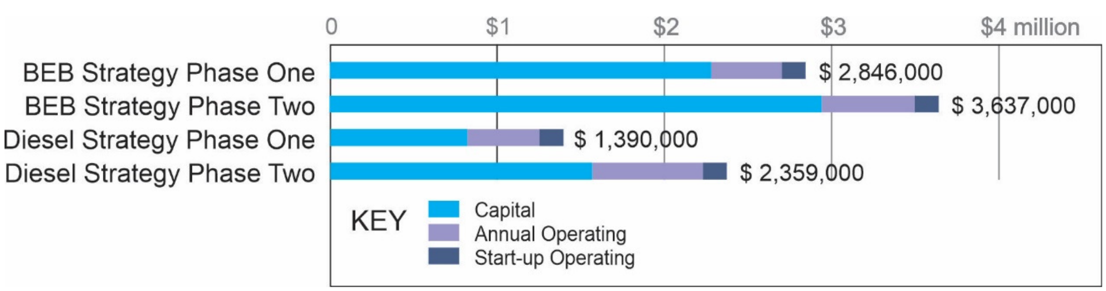


Figure 9-2: Total Year One Start-up Cost by Strategy

9.6 FUNDING OPTIONS THROUGH TAXATION

Although some funding can be secured through fares, advertising, and programs offered by other levels of government, the bulk of the cost of the transit service will need to be funded through municipal taxation. There are two general approaches to taxation. One is through the general tax rate and the other is through an area rate. The rationale for using an area rate is that it applies only to those residents and businesses that stand to benefit directly from the service. Using the general tax rate can also be justified by recognizing that public transit provides a benefit to all through reduction of emissions, noise, traffic and parking demand, and promotion of social equity and climate change goals.

Setting the geographic bounds for an area rate typically involves measuring the walking distance from each bus stop or drawing lines parallel to the route. The distance used for either measurement can be anywhere from 450m to 1000m.

Taxation can also be based on a blend of these two approaches. Halifax Transit, for example, funds its transit service partly from an area rate set at a one kilometer crow-flies distance from the nearest transit route and partly from the general rate.

External opportunities for funding are summarized in Appendix C. None of these funding opportunities have been included in the project cost analysis.

10 SUMMARY AND RECOMMENDATIONS

10.1 SUMMARY

The starting point for this study was the routing and service plan identified in the 2020 Study. Considering changes to growth, the road network and advancing transit technology, several adjustments were made.

Although the routing continued to respect the concept of a one-hour cycle between Halifax Stanfield Airport and Lantz, some minor modifications were made The final routing plan, along with proposed bus stop locations, is provided in Appendices A and B.

In this study, we began with a broad assessment of the feasibility of different bus types and sizes to provide effective service. Following a series of discussions with stakeholders, we refined our focus to four potential strategies, as outlined in Table 10-1 below.

Table 10-1: Summary of Proposed Bus Deployment Strategies for East Hants Transit

Strategy	# of Buses	Bus A	Bus B	OPEX ($CAD)	GHG (tonne)
BEB - Phase 1	2	BEB	Diesel	$425,900	98
BEB - Phase 2	2	BEB	BEB	$556,700	133
Diesel - Phase 1	1	Diesel	-	$429,700	151
Diesel - Phase 2	2	Diesel	Diesel	$658,600	244

We recommend that East Hants Transit begin with the BEB Strategy Phase 1, transitioning to Phase 2 with two BEBs only as service demand grows. To enable BEBs to cover longer distances, battery top-ups during service hours are necessary. Under Phase 1, BEBs would return to the Sportsplex for mid-day charging, with a diesel bus deployed on the route during this period, ensuring BEBs maintain enough charge to complete scheduled service. As demand increases, the diesel bus could be replaced by an additional BEB.

While initial CAPEX for BEBs may be higher, they offer significant lifecycle OPEX savings, as outlined in this report, and support GHG emissions reduction.

There are two viable alternatives for operation of the service – operation by the Municipality or operation by East Hants Community Rider (EHCR) with funding from the Municipality. We believe that the OPEX figures we have determined are common to both alternatives, with the exception of provision of a spare bus and deployment of drivers. EHCR may have a small advantage in being able to shift buses and drivers between their on-demand service and the fixed route service. The Municipality, on the other hand, may realize an advantage in getting access to future Federal infrastructure funding programs that a non-municipal entity may not.

Our observation from examples in Nova Scotia is that the not-for-profit community groups are fully capable of delivering on-demand services but find the addition of operating a fixed route service a significant challenge. In the case of EHCR, however, we see a well-run organization, with an excellent relationship with the Municipality, that appears interested in taking on the challenge of fixed route service.

If the Municipality were to consider entering into an agreement with EHCR, it should be expected that all of the capital and operating costs (other than those that might be covered by external grants) will be paid for by the Municipality. The figures in this report give a good estimation for first year costs, but ongoing budgets will be based on past years' experience. A grant will need to be provided to EHCR for the purchase of buses.

10.2 RECOMMENDATIONS FROM THE 2020 STUDY

Several recommendations from the 2020 Study remain valid and are listed below. Note that the wording is taken directly from the 2020 Report and there are some references to sections within that document.

1. NEGOTIATE A CAPITAL GRANT WITH HALIFAX STANFIELD AIRPORT AUTHORITY FOR PURCHASE OF VEHICLE

The Halifax Stanfield Airport Authority has indicated their support for public transit providing service to the airport. Several years ago, they committed a one-time capital grant to Halifax Transit which launched service to the airport. The Municipality should be aware that such a grant from the Airport Authority will be accompanied by an agreement which will require a pro-rated repayment of the grant should the transit service discontinue operation within a stated period of time (likely three to four years).

2. ENTER INTO AN AGREEMENT WITH HALIFAX STANFIELD AIRPORT AUTHORITY TO USE THE AIRPORT BUS STOPS

The use of the existing bus stops at the terminal curbside and on Barnes Drive will be a critical component to the East Hants service. Entering into an agreement with the Airport Authority will establish a commitment from both parties to ensure that these stops will be used in accordance with the needs of each party.

3. ENTER INTO AN AGREEMENT WITH ELMSDALE SUPERSTORE FOR THE USE OF THEIR PROPERTY FOR A BUS STOP AND ADDED INFRASTRUCTURE

The routing plan uses a service road on the Superstore property for a bus stop and recommends the addition of a curb and sidewalk to aid in boarding of wheelchairs. This agreement will commit the Municipality to maintenance of and liability at the stop.

4. SET A BOUNDARY FOR A TRANSIT TAX AND DETERMINE A TAXATION RATE

The proposed East Hants transit service will provide an important new municipal service to many area residents but will provide little or no value to residents who are outside of reasonable walking distance to the route. A transit service boundary should be established and residential properties within that boundary should have a transit rate added to their assessed tax bill based on the added operating cost to the municipality. Although the existing service area boundary, or other already-defined municipal boundaries, may be suitably applied for this purpose, HRM has found that a separate boundary needed to be drawn to ensure that only those within a specified distance of a bus stop (one kilometer in HRM's case) would pay the transit tax. East Hants should consider what makes the most sense in their circumstances and set the tax rate boundary as appropriate.

5. APPROACH LOCAL MERCHANTS AS SALES AGENTS FOR MONTHLY TRANSIT PASSES AND ROUTE MAPS

Identify and approach local commercial merchants within the community to serve as sales agents for monthly transit pass purchasing and route map distribution locations. In addition to municipal buildings (e.g. Sportsplex, Aquatic Centre, Library/Municipal Building), the location where monthly passes are to be sold should be at popular destination points and distributed across the designated route. It should be noted that it is typical for merchants to be paid a level of commission for pass sales however other service providers in the province (e.g. Bridgewater), have had local merchants waive those fees. It will be up to the Municipality to make arrangements with appropriate vendors and encourage a zero-fee/zero-commission agreement for the sale of monthly passes.

6. CONFIRM PLACEMENT OF BUS STOP LOCATIONS WITH NS PUBLIC WORKS AND EAST HANTS ENGINEERING

Using the recommendations on bus stop placement in this report, the Municipality should work with Nova Scotia Public Work's regional manager to confirm bus stop locations and design. Locations will likely be evaluated based on vehicle on safety sight lines and driver ability to pull into and out of traffic easily. Also see Section 7.1 of this [2020] report.

7. NEGOTIATE AN AGREEMENT FOR INTER-AGENCY TRANSFERS WITH HALIFAX TRANSIT

Section 3.10 of this [2020] report described an approach to creating a fee structure for transferring between East Hants Transit and Halifax Transit that achieves a middle ground between paying a full double fare and free transferring. The Municipality should contact Halifax Transit to initiate discussion on this approach prior to service implementation.

8. FINALIZE TAXATION BOUNDARY AND TAXATION RATE

Staff should consider the final taxation boundary and rate for the transit service and have it incorporated into future budget reports to Council. In addition to boundary and assessed value rates, consideration for types of land uses should also be taken into account – specifically how (or if) commercial/employment area properties should be taxed to help contribute to the service for their employees and customers.

9. IDENTIFY ANY ADDITIONAL RESOURCES REQUIRED FOR BUS STOP MAINTENANCE

Additional maintenance and sidewalk clearing around bus stops may be required by Municipal forces. The level of expected service at bus stops should be established.

10. MARKETING AND COMMUNICATIONS PROGRAM AND CONTENT (PRE- AND POST-IMPLEMENTATION)

A level of marketing and communications with the community needs to be done to ensure residents and businesses know that the service is being planned for during pre-implementation phases, as well as when it launches and all information regarding the service itself.

11. APPROACH POST-SECONDARY INSTITUTIONS WITH A PROPOSAL FOR ACCEPTING U-PASS

Section 3.9 of this [2020] report discusses the potential of receiving revenue from post-secondary institutions that issue UPasses to their students in exchange for accepting UPass on East Hants Transit buses. Agreements would be required with each institution. To start, we recommend that the Municipality accept U-Passes with no agreement in place for a twelve-month test period, understanding that this represents lost revenue to the system. Necessary data can be collected through the course of this trial period to form the basis for a negotiation of U-Pass fees.

10.3 NEW OR REVISED RECOMMENDATIONS

Additional recommendations have been identified and discussed in this report, specifically in Sections 7 and 8. A summary of these recommendations is included below:

12. CONDUCT A BRANDING EXERCISE AND DESIGN A DISTINCTIVE BUS STOP SIGN

See Section 7.1 of this report.

13. COMMUNICATE WITH THE JOINT REGIONAL TRANSPORTATION AGENCY REGARDING INTEGRATION WITH REGIONAL TRANSIT

See Section 7.2 of this report.

13. NEGOTIATE WITH HALIFAX TRANSIT FOR SHARED USE OF THEIR FARE COLLECTION TECHNOLOGY AND THE HFXGO APP

See Section 7.3 of this report.

14. REQUEST A QUOTATION FROM DIGITAL FUSION INC. FOR A VEHICLE TRACKING APP MODELLED ON THE BRIDGEWATER TRANSIT APP

See Section 7.4 of this report.

15. WORK WITH THE MANAGEMENT OF THE EAST HANTS SPORTSPLEX TO DESIGN HOW BUS STOPPING, CHARGING AND OVERNIGHT STORAGE WILL WORK ON THEIR SITE

See Section 7.5 of this report.

16. TAKE STEPS TO HIRE NEW STAFF OR ADD TASKS TO EXISTING STAFF POSITIONS

See Section 8.1 of this report. Note that this recommendation is somewhat different that what was recommended in 2020. The change is based on having more experience with similar systems in Nova Scotia.

17. ENTER INTO AN AGREEMENT WITH ELMSDALE (SOBEY'S PLAZA) FOR THE USE OF THEIR PROPERTY FOR A BUS STOP AND ADDED INFRASTRUCTURE

See Section 3.7 of this Report. Note that this is essentially an extension of Recommendation #3.

10.4 FUTURE EXPANSION

Within the jurisdictional boundaries of East Hants, this study and studies leading up to it, have identified the Enfield-to-Lantz corridor as the area having the highest potential for generating transit trips. Accordingly, a daily fixed transit route with frequencies not exceeding one hour is the best investment for the Municipality in initiating public transit service. This study has also identified the value of extending that service in the future by expanding the service hours and increasing frequency to 30 minutes in the commuter peak periods.

In addition to service frequency expansion on the Elmsdale-to-Lantz corridor, geographic expansion of the service may be a future consideration. Figure 10-1 shows some opportunities for additional routes that can connect either to the Elmsdale-Lantz route, the proposed regional transit service, or Halifax Transit. This service can be complementary to the on-demand service currently provided by EHCR. Since the areas being served will not have the same potential for generating transit ridership, models other than a daily fixed route may be warranted. A **dynamic routing** model is one where a bus will be scheduled to service an area within a specified time frame. It may follow a defined route or pick up passengers at or near their door. Route segments or door stops will only be done when scheduled by the client (or a passenger requests a drop-off). A **temporal routing** model is one where a bus follows a fixed scheduled route but only provides service on a certain day(s) of the week, but runs throughout that day. Although a temporal model may not effectively service commute-to-work or school trips, it can be appealing to trips involving shopping, appointments, recreation or social activities which can be more readily scheduled to coincide with the day(s) transit is available.

The success or failure of fixed route service in the Airport-to-Lantz corridor can provide the rationale for whether or not additional services are considered in the future.

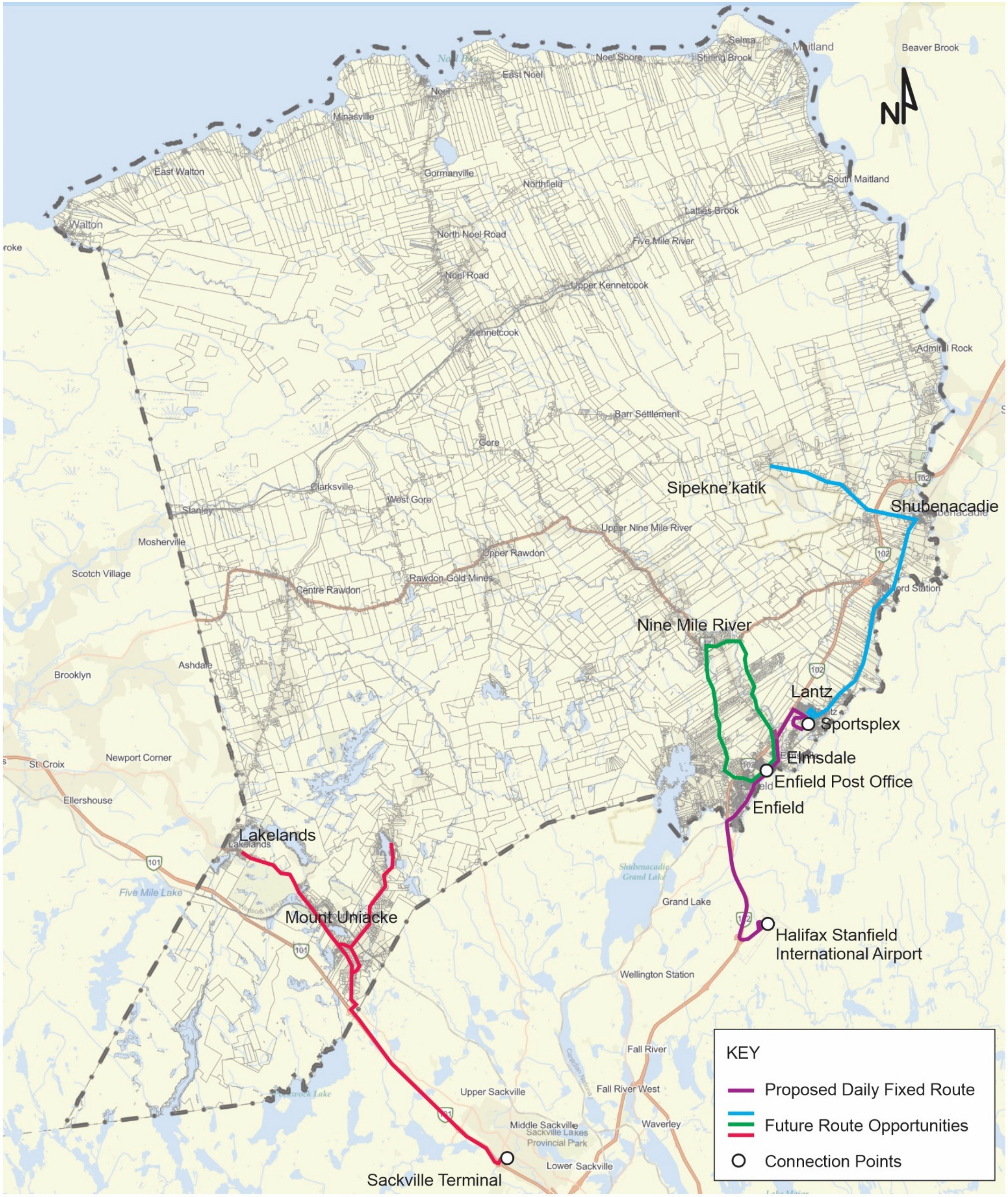


Figure 10-1: Future Route Opportunities

APPENDIX

A *BUS STOP LOCATIONS*

APPENDIX A: STOP LOCATIONS

Key to Stop Ratings

SIDEWALK?

- Stop has sidewalk (or multi-use pathway) adjacent
- Stop has no sidewalk adjacent, but there is a flat shoulder or parking area for waiting
- Stop has no sidewalk adjacent and has limited shoulder or a ditch

STREETLIGHT?

- Stop has streetlight overhead
- Stop has streetlight on the opposite side of the street or nearby
- Stop has no streetlight nearby

ADJACENT PROPERTY IMPACT?

- Stop is not adjacent to a house or business or is adjacent to an important destination
- Stop is adjacent to a business or to the side yard of a residence
- Stop is adjacent to the front yard of a residence

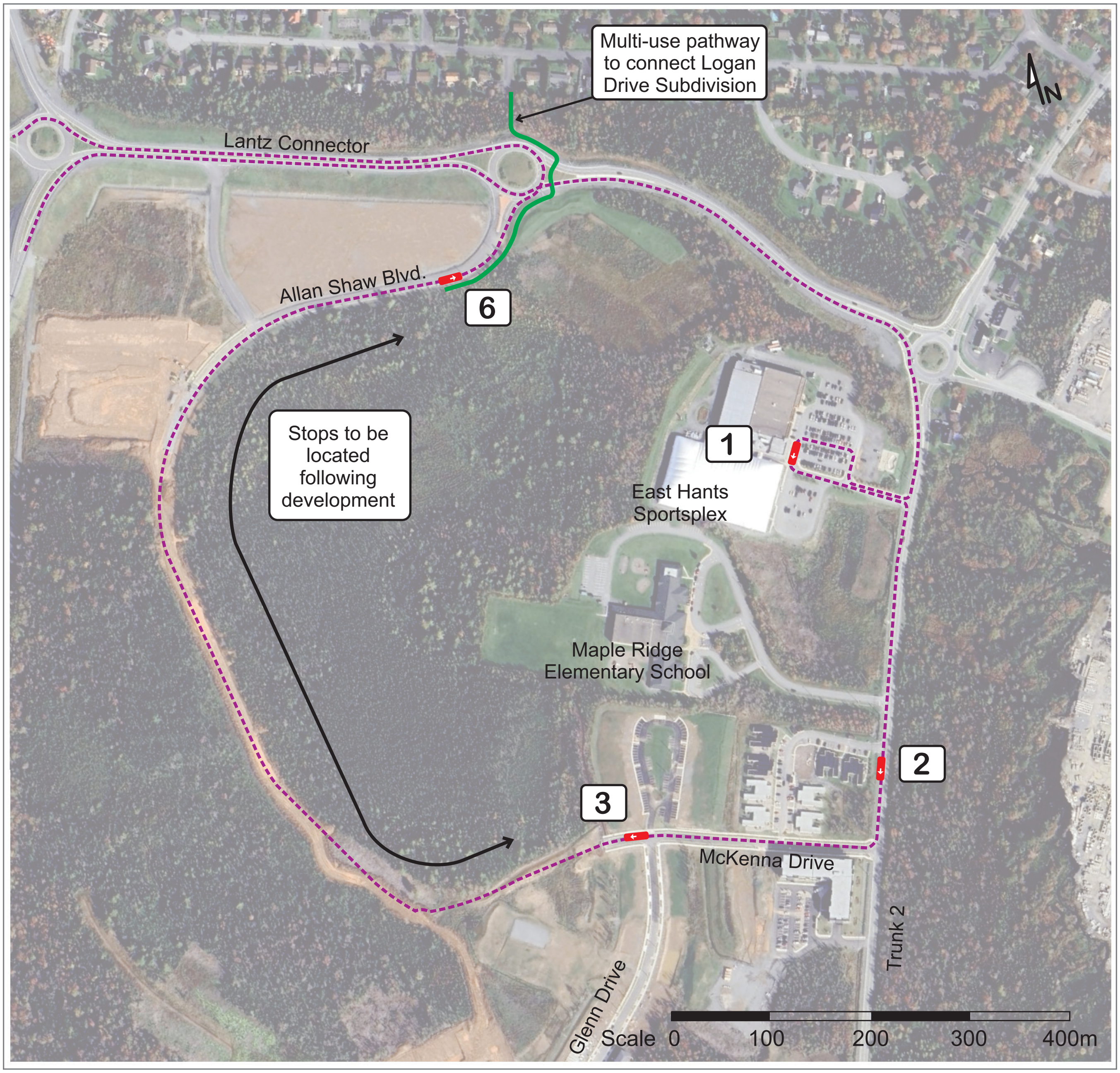
OFF-LINE OPPORTUNITY?

- Stop is fully out of traffic lanes
- Stop is in-line but on a low volume road/lane, or there is opportunity to locate the stop off-line
- There is no opportunity to locate the stop out of traffic lanes

CROSSWALK?

- A marked crosswalk is close to the stop
- A marked crosswalk is nearby
- There is no marked crosswalk in the vicinity

A blue box on the stop photo indicates the approximate location where the bus will stop



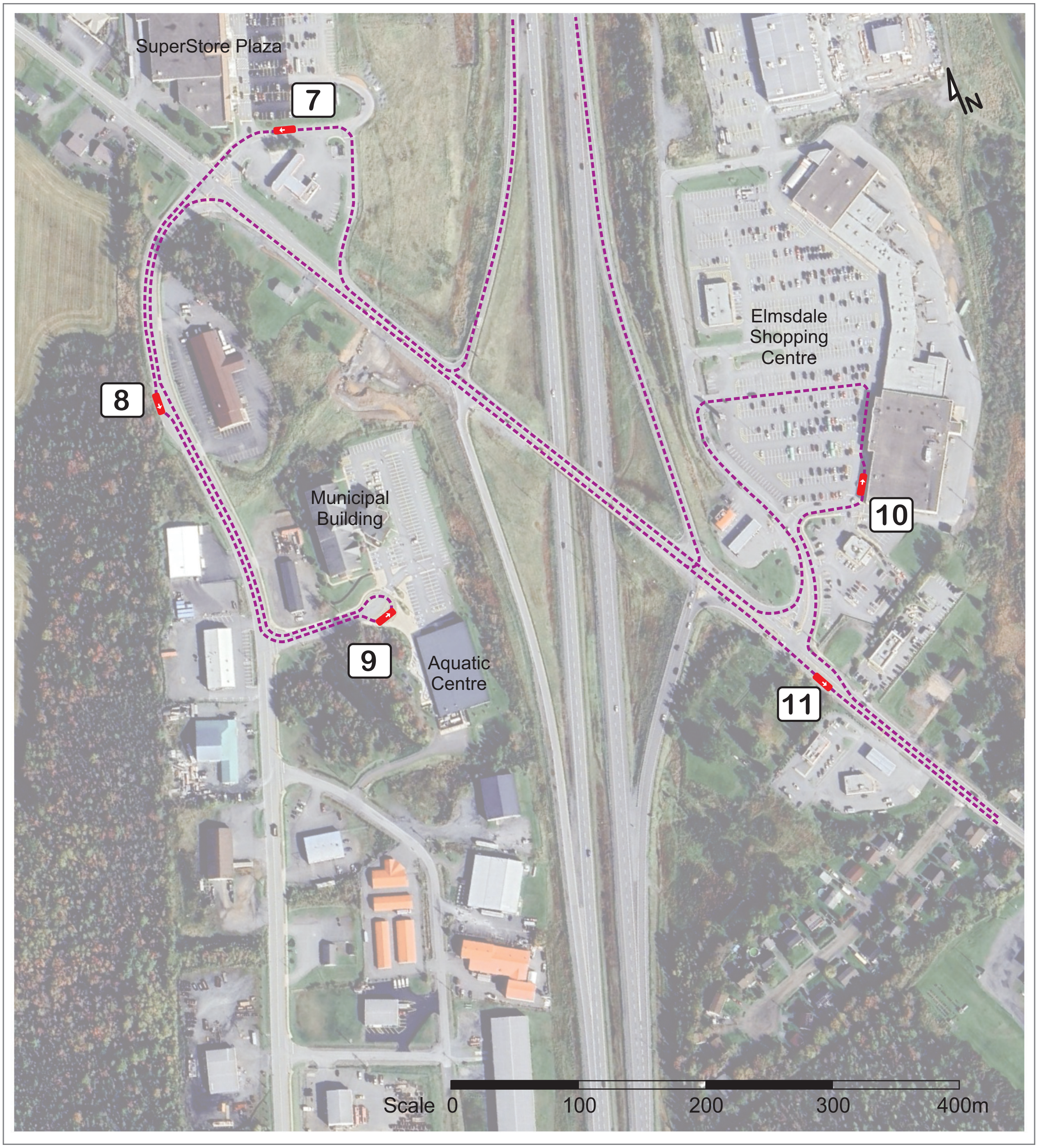
Multi-use pathway to connect Logan Drive Subdivision
Lantz Connector
Allan Shaw Blvd.
6
Stops to be located following development
1
East Hants Sportsplex
Maple Ridge Elementary School
2
3
McKenna Drive
Trunk 2
Glenn Drive
Scale 0 100 200 300 400m
N

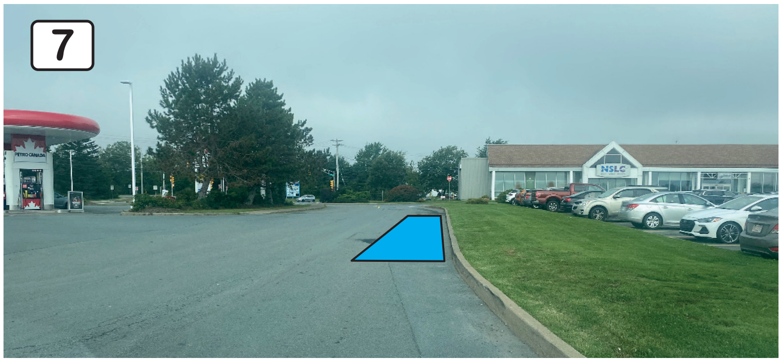
Sidewalk?	
Streetlight?	
Adjacent property impact?	
Off-line opportunity?	
Marked crosswalk?	

Sidewalk?	
Streetlight?	
Adjacent property impact?	
Off-line opportunity?	
Marked crosswalk?	

Sidewalk?	
Streetlight?	
Adjacent property impact?	
Off-line opportunity?	
Marked crosswalk?	

Sidewalk?	
Streetlight?	
Adjacent property impact?	
Off-line opportunity?	
Marked crosswalk?	


SuperStore Plaza
7
8
Municipal
Building
9
Aquatic
Centre
Elmsdale
Shopping
Centre
10
11
N
Scale 0
100
200
300
400m



Sidewalk?	
Streetlight?	
Adjacent property impact?	
Off-line opportunity?	
Marked crosswalk?	

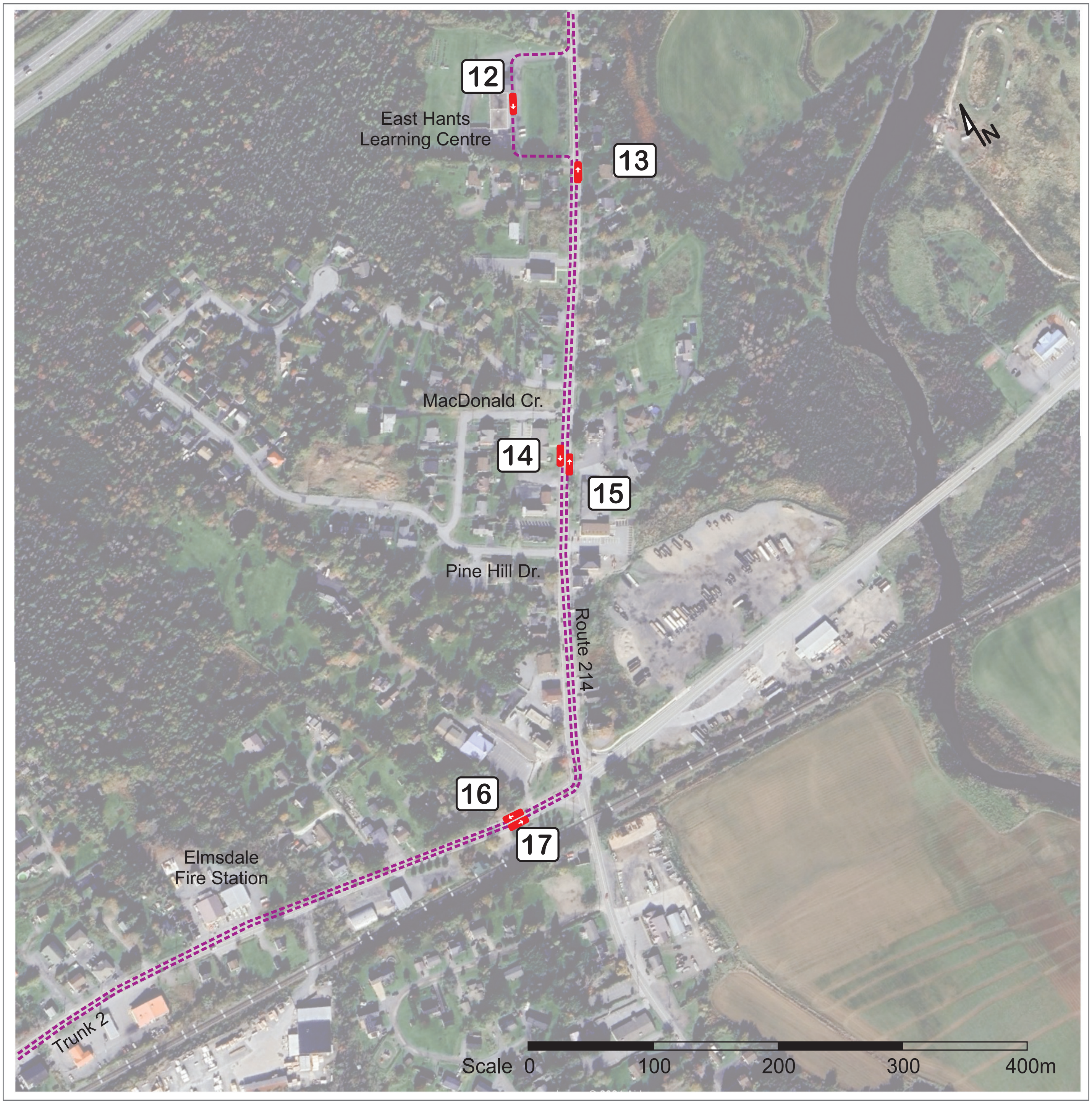
Sidewalk?	
Streetlight?	
Adjacent property impact?	
Off-line opportunity?	
Marked crosswalk?	

Sidewalk?	
Streetlight?	
Adjacent property impact?	
Off-line opportunity?	
Marked crosswalk?	

Note: Vehicle turning software has been used to confirm that a 35-foot transit bus is able to make this circular movement in a continuous path.

Sidewalk?	
Streetlight?	
Adjacent property impact?	
Off-line opportunity?	
Marked crosswalk?	

Sidewalk?	
Streetlight?	
Adjacent property impact?	
Off-line opportunity?	
Marked crosswalk?	


12
East Hants
Learning Centre
13
MacDonald Cr.
14
15
Pine Hill Dr.
Route 214
16
17
Elmsdale
Fire Station
Trunk 2
N
Scale 0
100
200
300
400m

Sidewalk?	(green)
Streetlight?	(green)
Adjacent property impact?	(green)
Off-line opportunity?	(green)
Marked crosswalk?	(red)

Sidewalk?	(yellow)
Streetlight?	(red)
Adjacent property impact?	(red)
Off-line opportunity?	(red)
Marked crosswalk?	(red)

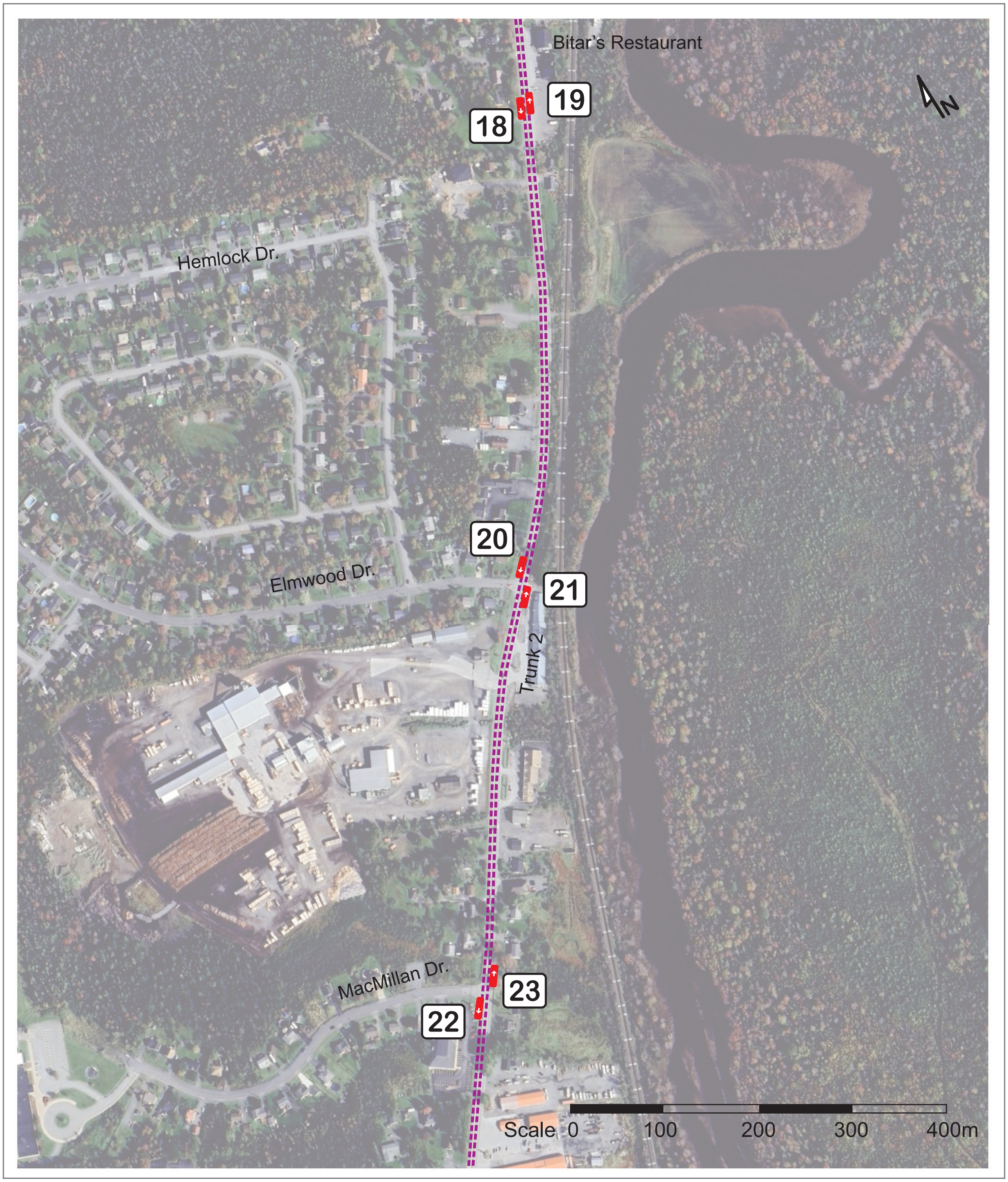
Sidewalk?	(green)
Streetlight?	(yellow)
Adjacent property impact?	(yellow)
Off-line opportunity?	(red)
Marked crosswalk?	(red)

Sidewalk?	(red)
Streetlight?	(green)
Adjacent property impact?	(green)
Off-line opportunity?	(red)
Marked crosswalk?	(red)

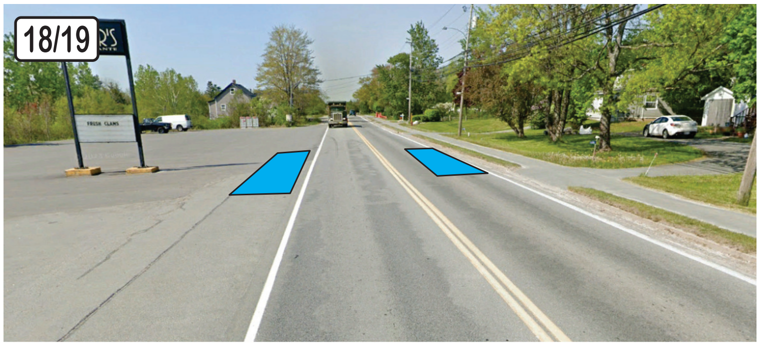
Sidewalk?	(green)
Streetlight?	(green)
Adjacent property impact?	(green)
Off-line opportunity?	(red)
Marked crosswalk?	(yellow)

Sidewalk?	(yellow)
Streetlight?	(yellow)
Adjacent property impact?	(green)
Off-line opportunity?	(yellow)
Marked crosswalk?	(yellow)

Note: Stop is located in right-turn channel



Bitar's Restaurant
19
18
Hemlock Dr.
20
Elmwood Dr.
21
Trunk 2
MacMillan Dr.
23
22
Scale 0 100 200 300 400m
N



Sidewalk?	
Streetlight?	
Adjacent property impact?	
Off-line opportunity?	
Marked crosswalk?	

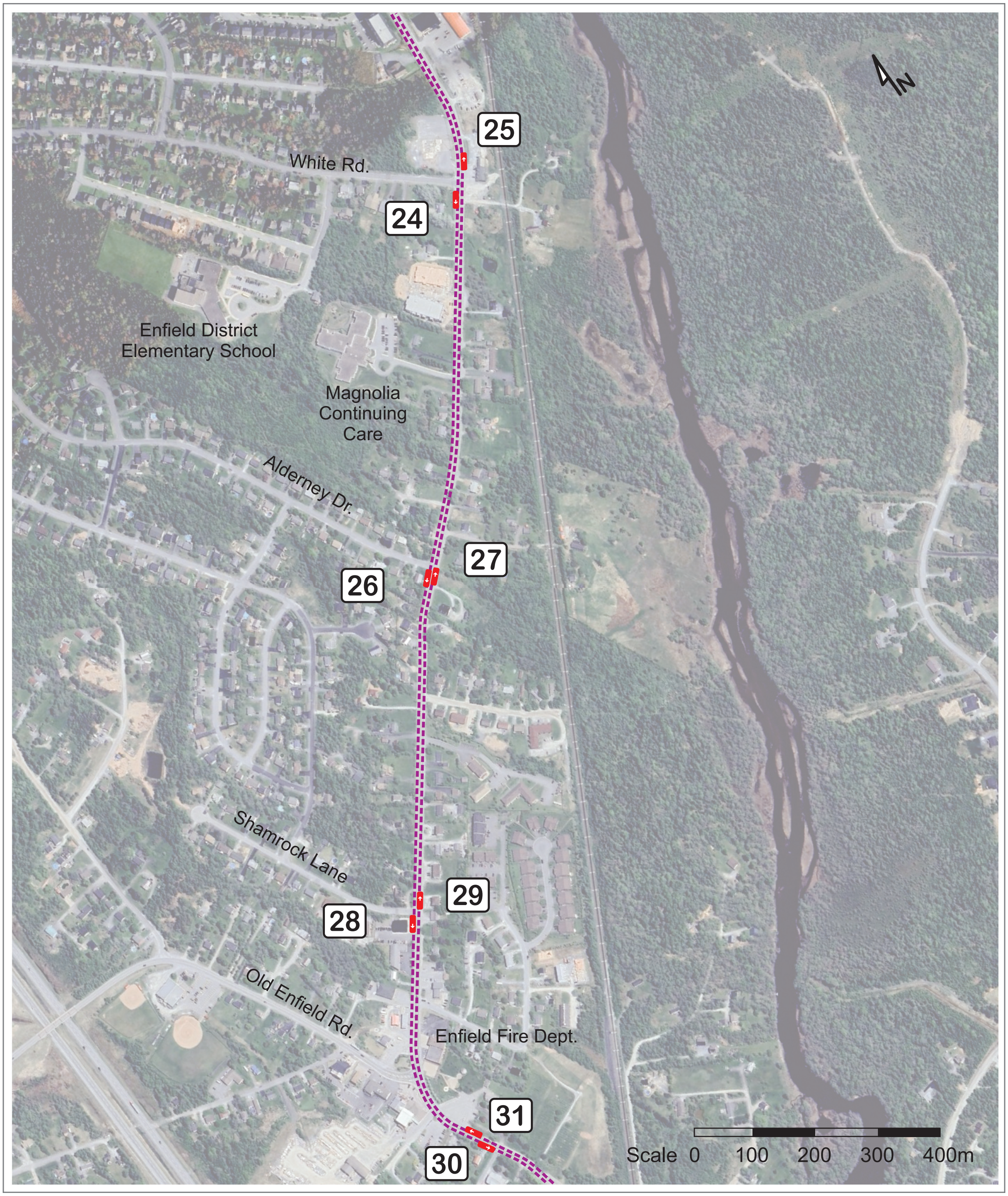
Sidewalk?	
Streetlight?	
Adjacent property impact?	
Off-line opportunity?	
Marked crosswalk?	

Sidewalk?	
Streetlight?	
Adjacent property impact?	
Off-line opportunity?	
Marked crosswalk?	

Sidewalk?	
Streetlight?	
Adjacent property impact?	
Off-line opportunity?	
Marked crosswalk?	

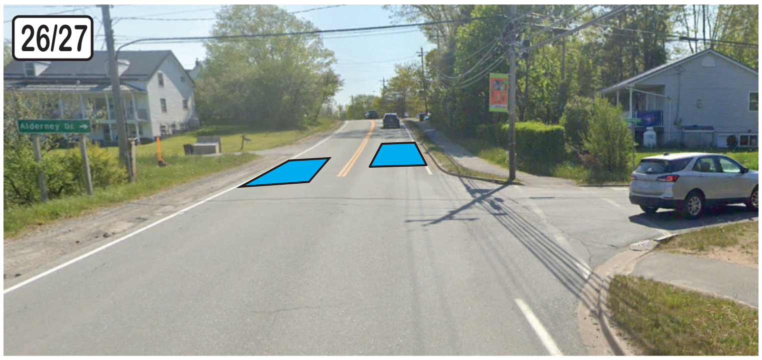
Sidewalk?	
Streetlight?	
Adjacent property impact?	
Off-line opportunity?	
Marked crosswalk?	

Sidewalk?	
Streetlight?	
Adjacent property impact?	
Off-line opportunity?	
Marked crosswalk?	


25
White Rd.
24
Enfield District
Elementary School
Magnolia
Continuing
Care
Alderney Dr.
27
26
Shamrock Lane
29
28
Old Enfield Rd.
Enfield Fire Dept.
31
30
N
Scale 0 100 200 300 400m

Sidewalk?	
Streetlight?	
Adjacent property impact?	
Off-line opportunity?	
Marked crosswalk?	

Sidewalk?	
Streetlight?	
Adjacent property impact?	
Off-line opportunity?	
Marked crosswalk?	

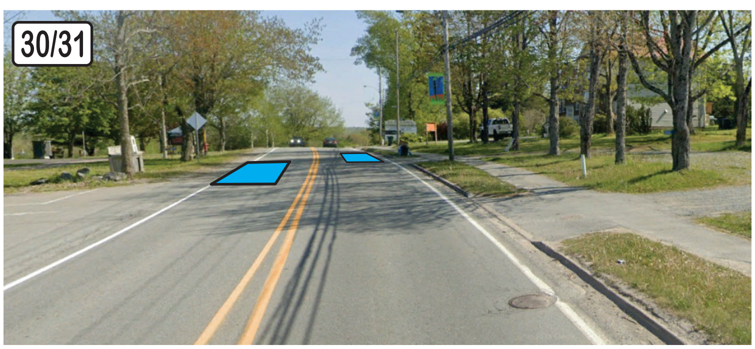


Sidewalk?	
Streetlight?	
Adjacent property impact?	
Off-line opportunity?	
Marked crosswalk?	

Sidewalk?	
Streetlight?	
Adjacent property impact?	
Off-line opportunity?	
Marked crosswalk?	

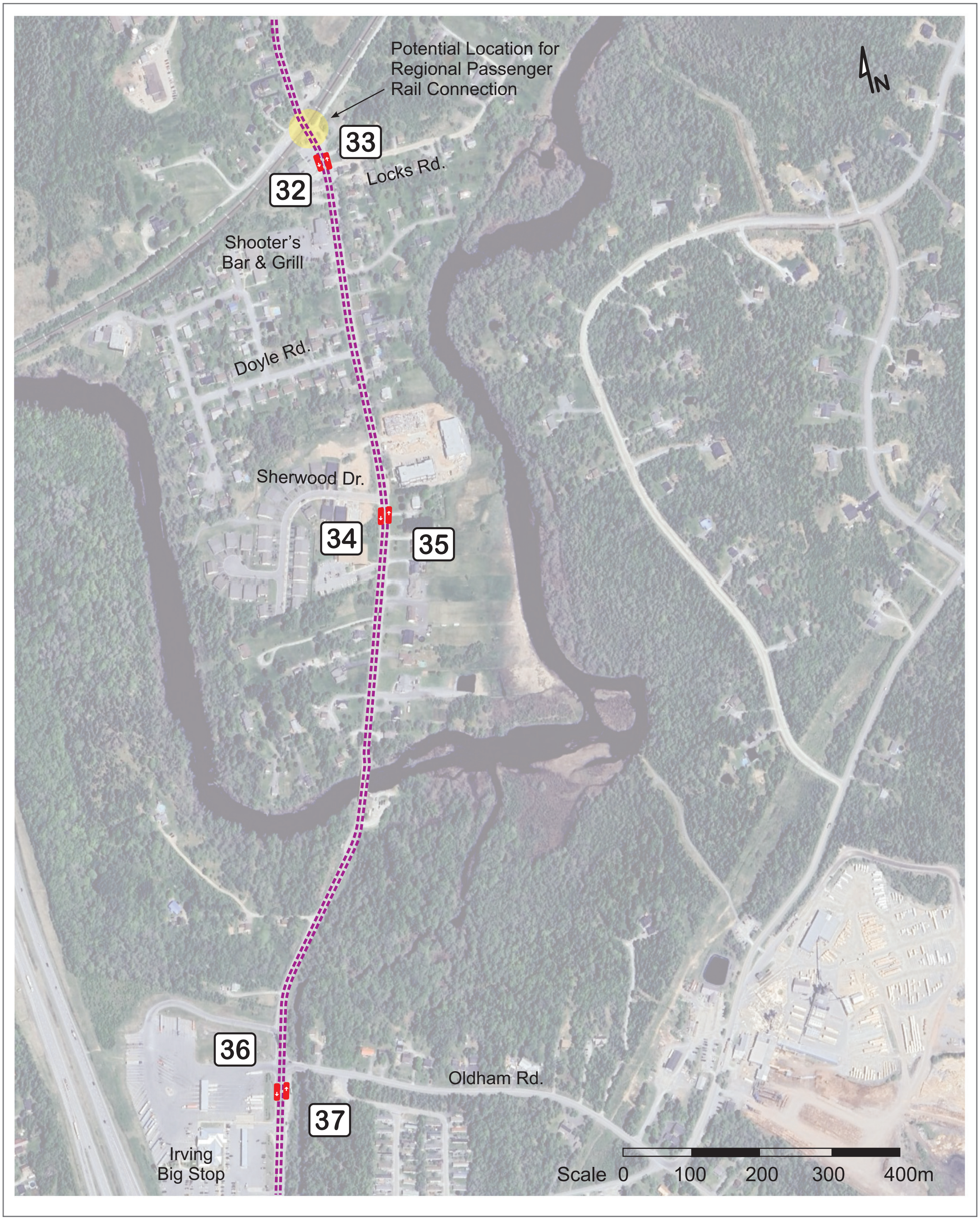
Sidewalk?	
Streetlight?	
Adjacent property impact?	
Off-line opportunity?	
Marked crosswalk?	

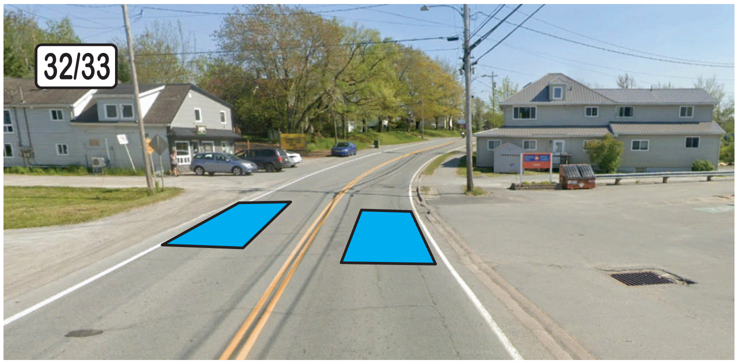
Sidewalk?	
Streetlight?	
Adjacent property impact?	
Off-line opportunity?	
Marked crosswalk?	



Sidewalk?	
Streetlight?	
Adjacent property impact?	
Off-line opportunity?	
Marked crosswalk?	

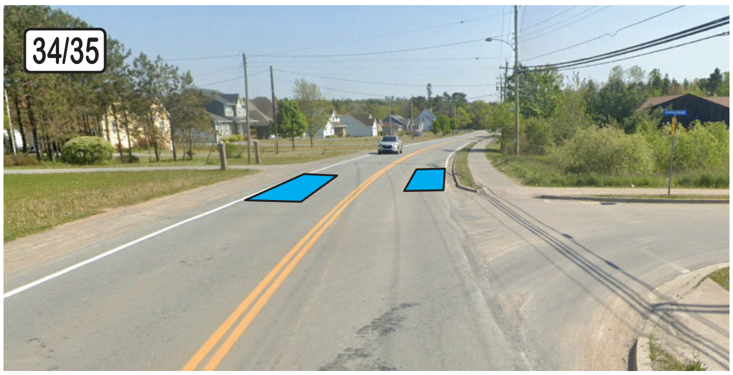
Sidewalk?	
Streetlight?	
Adjacent property impact?	
Off-line opportunity?	
Marked crosswalk?	


Potential Location for
Regional Passenger
Rail Connection
33
32
Locks Rd.
Shooter's
Bar & Grill
Doyle Rd.
Sherwood Dr.
34
35
36
Oldham Rd.
37
Irving
Big Stop
Scale 0 100 200 300 400m
N



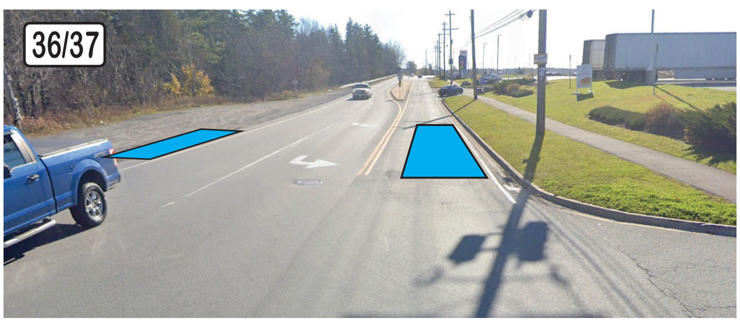
Sidewalk?	
Streetlight?	
Adjacent property impact?	
Off-line opportunity?	
Marked crosswalk?	

Sidewalk?	
Streetlight?	
Adjacent property impact?	
Off-line opportunity?	
Marked crosswalk?	



Sidewalk?	
Streetlight?	
Adjacent property impact?	
Off-line opportunity?	
Marked crosswalk?	

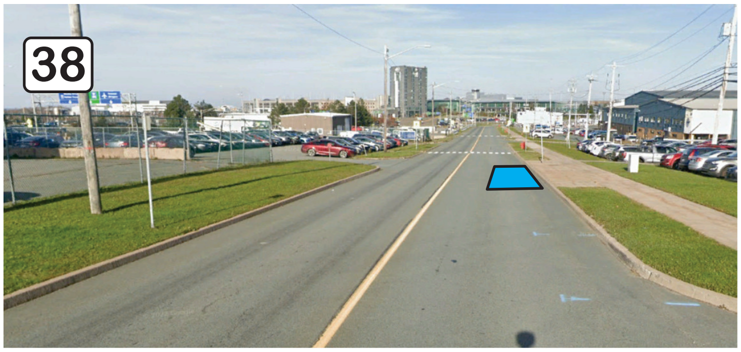
Sidewalk?	
Streetlight?	
Adjacent property impact?	
Off-line opportunity?	
Marked crosswalk?	



Sidewalk?	
Streetlight?	
Adjacent property impact?	
Off-line opportunity?	
Marked crosswalk?	

Sidewalk?	
Streetlight?	
Adjacent property impact?	
Off-line opportunity?	
Marked crosswalk?	


N
Terminal
Building
Alt Hotel
39
Barnes Dr.
38
Scale 0
100
200m



Sidewalk?	
Streetlight?	
Adjacent property impact?	
Off-line opportunity?	
Marked crosswalk?	

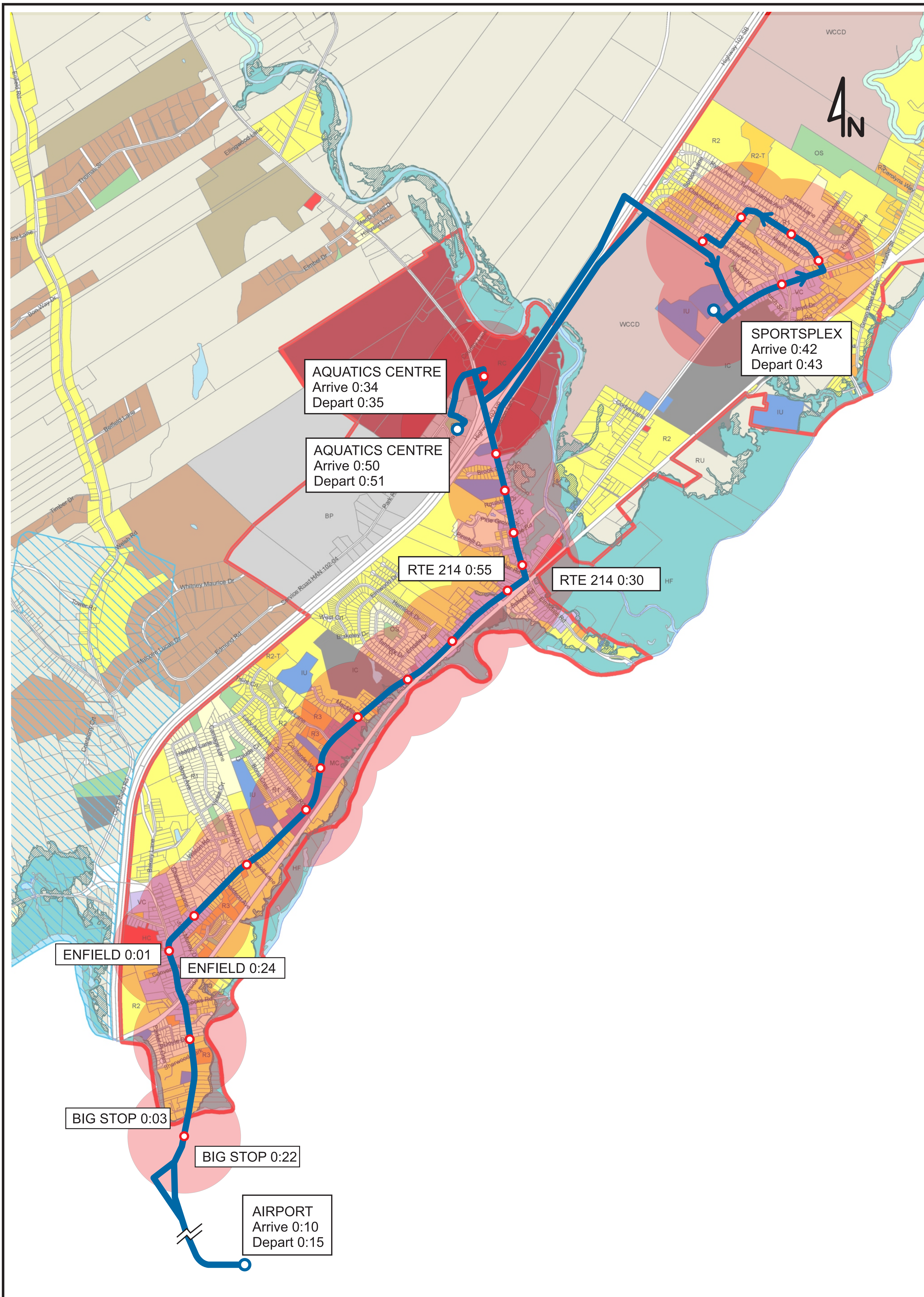
Note: This stop is shared with Halifax Transit

Sidewalk?	
Streetlight?	
Adjacent property impact?	
Off-line opportunity?	
Marked crosswalk?	

Note: This stop is shared with Halifax Transit

APPENDIX

B *DETAILED ROUTING PLAN*



PROJECT:

TRANSIT PLAN UPDATE

EAST HANTS , NOVA SCOTIA

TITLE:

MAP 1

ROUTE LAYOUT (2020 PLAN)

CLIENT:

MUNICIPALITY OF EAST HANTS

Drawn: D. McCusker

Reviewed:

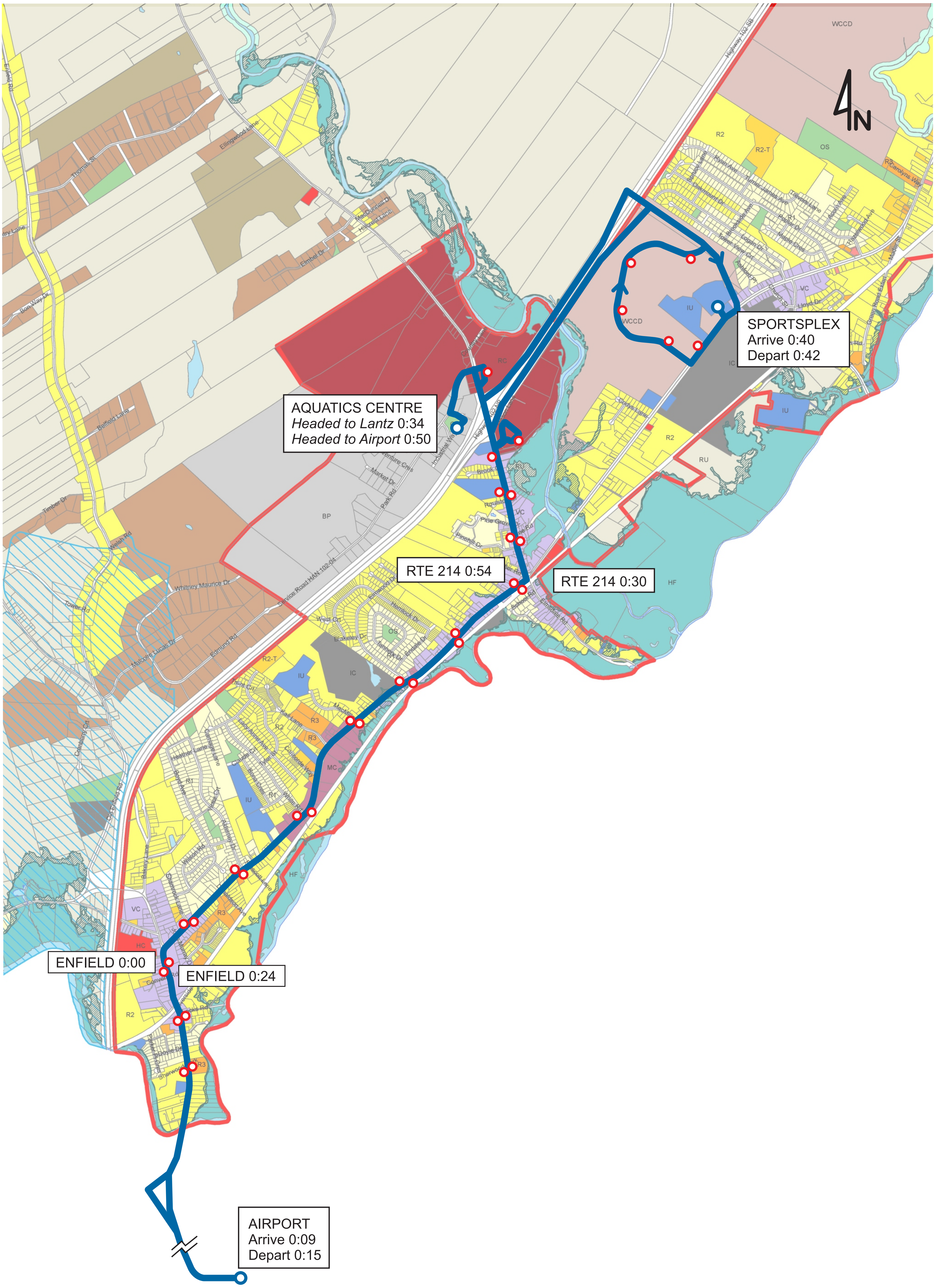
Project#: 191-16087

Date: 2020-03-18

- Bus Stop
- Timing Point
- 400m Radius Walking Distance

1 : 25,000 SCALE

WSP Canada Inc.
1 Spectacle Lake Drive
Dartmouth, Nova Scotia, Canada B3B 1X7
T 902-835-9955 www.wsp.com



Note: Times given at timing points refer to minutes past the hour

PROJECT: **TRANSIT SERVICES 2024 UPDATE**	CLIENT: **MUNICIPALITY OF EAST HANTS**	Bus Stop Timing Point	WSP Canada Inc. 1 Spectacle Lake Drive Dartmouth, Nova Scotia, Canada B3B 1X7 T 902-835-9955 www.wsp.com
TITLE: **MAP 2** **ROUTE LAYOUT (2024 PLAN)**	Drawn: D. McCusker Reviewed: Project#: CA0033180-2615 Date: 2024-10-28	1 : 25,000 SCALE	

APPENDIX

C *FUNDING OPPORTUNITIES*

APPENDIX C: Funding Opportunities

There are several funding opportunities available that the Municipality may wish to pursue. None of these have been included in the financial tables included in this report.

Halifax Stanfield Airport

The Halifax Stanfield Airport Authority has indicated their support for public transit providing service to the airport. Several years ago, they committed a one-time capital grant to Halifax Transit which launched service to the airport. The Municipality should be aware that such a grant from the Airport Authority will be accompanied by an agreement which will require a pro-rated repayment of the grant should the transit service discontinue operation within a stated period of time (likely three to four years).

Nova Scotia Transit Research Incentive Program

The NS-TRIP program can provide funding for projects associated with the start-up of a municipal fixed route service. At this stage of the process for East Hants, funding may be available for the start-up engineering (identified in Table 9-3) and operation of a pilot service. East Hants would not qualify for other provincial funding sources such as CTAP and ATAP as they are intended for areas with lower population density.

Federal Programs for Electric Buses

This section summarizes key insights on available public grant funding, financing and cost-offsetting opportunities for transit agencies in Nova Scotia to purchase and operate BEBs, chargers and other relevant infrastructure falling within the transit garage battery limits.

Overall, an assessment of the opportunities reveals that:

- Existing federal programming offers an opportunity to cover a substantial portion of battery electric bus and charging equipment costs through a combination of grant funding and low-interest loan financing. However, the following additional factors will further influence fund structuring for East Hants' transit electrification capital project/program.
    a. The level of alignment in East Hants' capital project timelines and HICC's (Housing, Infrastructure and Communities Canada, previously Infrastructure Canada) existing or anticipated Targeted Funding[1] timelines will directly impact the extent of project costs that can be subsidized through dedicated zero emission or rural transit funding. While contribution agreements to HICC's existing Targeted Funding programs such as the Zero Emissions Transit Fund (ZETF) and the Rural Transit Solutions Fund (RTSF) will terminate at the end of FY 2025-26 (i.e. March 2026), HICC is likely to defer acceptance of new funding applications to the ZETF or RTSF programs until their replacement by new equivalents which will be part of the newly announced Canada Public Transit Fund (CPTF). The CPTF, announced in August 2024, will fund transit infrastructure starting in FY 2026-27 (i.e. April 2026).
    b. The probability of successfully acquiring loan financing, which is offered by the Canada Infrastructure Bank (CIB), will depend on the scale of East Hants' electrification project/program.

[1] Targeted Funding implies specific HICC programming that supports local needs and federal priorities such as rural transit, active transportation and zero emission solutions.

c. Funding opportunities from other national not-for-profit organizations such as the Federation of Canadian Municipalities (FCEM) may be considered as an alternative to contributions from federal programs.
d. Municipal contribution equivalent to at least the cost of purchasing diesel buses, combined with a provincial contribution, will be imperative to bridge any remaining funding gaps.

- No funds are available for any of the transit electrification project assets at the provincial level - from the provincial government or other regional organizations - at the time of writing of this report. The local government(s) funding East Hants' transit assets may have to lobby the Province of Nova Scotia for contributions to this project depending on funding gaps and municipal and regional budgeting constraints.
- Should East Hants eventually consider applying to one of the existing or anticipated replacements of HICC's Targeted Funding programs (i.e. ZETF or RTSF), the decision between the ZETF and RTSF must be driven by:
  a. The eligibility of key project cost components[2] for funding from each of the ZETF and RTSF programs.
  b. The implication of funding program terms and conditions on the municipal funding bill, or in other words, the eventual municipal contribution requirement based on a confirmation from HICC on federal stacking limits.

The following table maps funding recommendations from various sources based on currently available or typical contributions from organizations at different levels of government / geography.

[2] It is recommended that East Transit undertake a detailed fund mapping at a level 2 or 3 cost breakdown structure following the generation of a Class 4 or 3 capital cost estimate for the project to better understand the total feasible funding from different combinations of federal programs.

Sr. No.	Scope Item / Lifecycle Component / Project Work Package / Asset Type	Considerations for East Hants Fleet Electrification Project	Federal Contribution Opportunity by Source	Provincial Contribution Opportunity by Source	Municipal / Regional Contribution Opportunity by Source
1.	Zero emission bus (ZEB) procurement	1-2 BEBs	• HICC ZETF program: Non-repayable grant up to 50%[3] (Oversubscribed, ending in Mar-2026 and to be replaced under CPTF) • CIB ZEB Initiative in conjunction with HICC ZETF: Flexible financing up to remaining 50% depending on operating cost savings assessment. • HICC RTSF program: Grant funding up to 80% of eligible capital expenses (Ending in Mar-2026 and to be replaced under CPTF)	No known funding programs for transit fleet electrification projects[4]	Equivalent of diesel bus total cost of ownership (TCO)[5] or more depending on funding gaps and municipal / regional budget
2.	Charging equipment procurement and installation	Slow plug-in	• HICC ZETF program: Non-repayable grant up to 50% (Same note as above) • NRCan ZEVIP program: Non-repayable grant up to 50% of total project costs[6]	No known funding programs for transit fleet electrification projects	Additional contribution depending on funding gaps and municipal / regional budget
3.	Utility Infrastructure procurement and installation	transformer and switchgear upgrades	• HICC ZETF program: Non-repayable grant up	No known funding programs for transit	Additional contribution depending on

[3] Please refer to respective program application guides at the time of application for nuances on eligible expenditure types for a particular scope item, lifecycle component, project work package or asset type
[4] Including, from the provincial government or local organizations acting as federal funding delivery organizations in Nova Scotia or Atlantic Canada
[5] Amounting to approximately $800,000 to $1.2 million depending on diesel bus price as well as 12-year lifecycle operating and maintenance costs for Atlantic Canada at the time of TCO estimation
[6] The ZEVIP program funds up to 50 per cent of Total Project Costs up to a maximum of $10 million per project. The contribution limit remains to be clarified with NRCan in instances where the definition or scope boundaries of "the Project" extend beyond charging or hydrogen refueling equipment to a full value chain including BEBs, charging equipment and bus depot like it would be in the case of this project.

Sr. No.	Scope Item / Lifecycle Component / Project Work Package / Asset Type	Considerations for East Hants Fleet Electrification Project	Federal Contribution Opportunity by Source	Provincial Contribution Opportunity by Source	Municipal / Regional Contribution Opportunity by Source
			to 50% (Same note as above)	fleet electrification projects	funding gaps and municipal / regional budget
4.	Bus depot retrofit or new construction	One facility	• HICC ZETF program: Non-repayable grant up to 50% (Same note as above)	No known funding programs for transit fleet electrification projects	Additional contribution depending on funding gaps and municipal / regional budget

While oversubscribed and approaching their termination dates in March 2026, the following subsections summarize key features of HICC's existing ZETF and RTSF programming to serve as anticipatory references for similar new Targeted Funding programs expected under the Canada Public Transit Fund (CPTF), starting in April 2026.

Housing Infrastructure and Communities Canada (HICC) Zero Emission Transit Funding (ZETF) Program and Canada Infrastructure Bank (CIB) ZEB Initiative[7]

The ZETF program has made $2.75 billion in federal investment available to public transit and school bus operators from 2021 to 2026 to support the purchase of ZEBs, charging or hydrogen refueling infrastructure installation, and transit operation and maintenance facility upgrades. HICC funding will be allocated in close partnership with the CIB. The CIB's $1.5 billion ZEB initiative provides flexible financing supplementing non-repayable grant funding from the ZETF program. CIB financing relies on the premise of debt service of for ZEB procurement loans from the forecasted lifecycle operating cost savings of ZEBs compared to diesel buses. However, such financing is currently feasible only for BEBs because of the high fuel costs, and consequently, operating costs, associated with clean hydrogen fuel cell electric buses (FCEBs) compared to diesel buses.

Transit agencies as well as provincial, territorial, municipal or regional governments, among others recipient types, are eligible to receive funding from this program. The maximum contribution towards capital projects is up to 50 per cent of the total eligible costs. HICC will ensure that its total combined funding contribution and CIB financing does not exceed 100 per cent of the eligible costs.

Key eligible capital expenditures include:

- Procurement of ZEBs
- Procurement and installation of charging or hydrogen refueling equipment
- Retrofits to, or construction of new, transit parking and maintenance facilities

[7] Zero Emission Transit Fund, Application Guide.

Non-capital expenditures such as costs associated with warranties, OEM-supplied training, consultation with Indigenous groups, climate and resiliency assessments, project-specific labour and project monitoring costs are also eligible for funding. The ZETF program typically covers up to $350 million for a project. **Eligible expenses must be claimed by Fall of 2025** unless otherwise agreed between the recipient and HICC.

ZETF applications involve two stages – the submission of an expression of interest (EOI) followed by a Stream 1 or 2 application.

- Stream 1 (Planning Stream) of the ZETF program funds studies, modelling and feasibility analyses that will inform capital project planning.
- Stream 2 (Capital Project Stream) of the ZETF program funds capital projects planned based on robust ZEB fleet implementation planning. It funds the procurement, construction and commissioning stages of the project lifecycle.

HICC follows up on EOI submissions with an invitation to submit a full application to the appropriate stream based on the thoroughness of ZEB fleet implementation planning completed by the applicant. **Applications are assessed by both HICC and the CIB, beginning at the first stage (EOI) itself. ZETF funding and CIB financing does not require separate applications.**

Canada Public Transit Fund (CPTF)

The Canada Public Transit Fund (CPTF), announced in August 2024, is set to fund transit infrastructure starting in FY 2026-27. The program aims to support public transit and active transportation system expansions, improvements, and state of good repair projects. It includes a $500 million annual envelope, with allocations based on ridership and population metrics. The CPTF will replace existing programs like the ZETF and RTSF, and will require municipal and provincial contributions to bridge funding gaps. The program also emphasizes the importance of meeting specific housing conditions to advance housing outcomes as part of complete and inclusive transit-oriented communities.[8]

HICC Rural Transit Solutions Fund (RTSF)[9]

The RTSF targets the development of transit solutions in rural and remote communities. It was launched in 2021 and provides $250 million in federal funding over five years to support the development of locally-driven transit solutions. RTSF aims to help rural, remote, Northern, and Indigenous communities to develop and offer new public transit options to their residents.

The program offers funding through two streams:

- Planning and Design Projects Stream
- Capital Projects Stream

The Capital Projects Stream funds activities supporting the delivery of capital projects that avail rural transit solutions. These may include traditional solutions such as fixed-route buses and non-traditional solutions such as ride-share or on-demand services requiring the purchase of minivans, small craft, zero-emission fleets, shared fleets, the construction of intermodal hubs, the installation of charging stations or the purchase of software.

[8] Canada Public Transit Fund (CPTF)
[9] Rural Transit Solutions Fund, Application Guide

While there is no limit to the capital cost of a project, eligible applicants will be able to acquire maximum federal contributions of:

- $3 million to cover the capital costs of a new or expanded conventional transit solution (such as, purchase of internal combustion engine or hybrid vehicles, or digital platforms)
- $5 million to support zero-emission transit solutions (such as, for the purchase of zero-emission vehicles)

The RTSF can fund expenses that are direct and necessary for the successful implementation of a proposed public transit solution. Eligible capital expenditures can include:

- Procurement of vehicles, including but not limited to those that are zero-emission, buses, minivans, or small craft
- Procurement of fixed assets, such as charging stations
- Construction of bus stops, signage or the installation of charging stations
- Engineering and consultation fees, including those associated with maintaining, building, renovating or improving fixed capital assets (such as, garage, bus station, etc.) during the period of the project
- Active transportation components, such as pathways and trails, that help facilitate mobility and are integrated within a rural transit system
- Costs incurred for consultation or engagement with Indigenous peoples on the project and expenditures incurred for accommodation of adverse impacts on Aboriginal and Treaty rights
- Costs associated with data collection, project evaluation, the exchange of information and dissemination of project results
- Other costs that are considered to be direct and necessary for the successful implementation of the project and are approved in advance by Infrastructure Canada.

Natural Resources Canada (NRCan) Zero Emission Vehicle Infrastructure Program (ZEVIP)[10] and CIB Charging and Hydrogen Refueling Infrastructure Initiative

Recapitalized by budget 2022 with an additional $400 million, and extended to March 31, 2027, NRCan's ZEVIP program invests in large-scale zero emission vehicle (ZEV) charging and refuelling infrastructure that is revenue generating and in the public interest. The program is complemented by $500 million in financing from the CIB's Charging and Hydrogen Refueling Infrastructure Initiative.

Out of the three, the **stream for owners / operators of ZEV infrastructure** provides funding towards projects focusing on EV charger deployment in public places, on-street, in multi-unit residential buildings, at workplaces, and for vehicle fleets. **Applications for this stream through an annual request for proposals (RFP) are expected to reopen in Spring 2024**.

The other two funding streams within the program are for Delivery Organizations and Indigenous Organizations. At the time of writing of this report, no Delivery Organization was identified to be funding charging equipment for transit projects in Nova Scotia or Atlantic Canada.

Project proposals for EV charging infrastructure must include:

- A minimum of one charger of 200 kW and above; or

[10] Zero Emission Vehicle Infrastructure Program funding for owners and operators of charging and refuelling infrastructure

- A minimum of two fast chargers of 50 kW and above; or
- A minimum of 20 chargers of all charging levels[11]

Fast chargers with multiple connectors and capable of charging multiple vehicles simultaneously and independently at a given output level may be eligible to receive additional funding. The funding amount of multi-connector chargers will be based on the maximum simultaneous output level of operating connectors.
Projects are selected through a competitive process, and NRCan's contribution is limited to 50 per cent of Total Project Costs up to a maximum of $10 million per project. More specifically, project proponents are entitled to the following maximum funding by charging asset type:

Type of infrastructure	Output	Maximum funding	Maximum funding for Indigenous businesses and communities
Level 2 (208/240 V) connector	3.3 kW to 19.2 kW	Up to 50% of total project costs, to a maximum of $5,000 per connector	Up to 75% of total project costs, to a maximum of $7,500 per connector
Fast charger	20 kW to 49 kW	Up to 50% of total project costs, to a maximum of $15,000 per charger	Up to 75% of total project costs, to a maximum of $22,500 per charger
Fast charger	50 kW to 99 kW	Up to 50% of total project costs, to a maximum of $50,000 per charger	Up to 75% of total project costs, to a maximum of $75,000 per charger
Fast charger	100 kW to 199 kW	Up to 50% of total project costs, to a maximum of $75,000 per charger	Up to 75% of total project costs, to a maximum of $112,500 per charger
Fast charger	200 kW and above	Up to 50% of total project costs, to a maximum of $100,000 per charger	Up to 75% of total project costs, to a maximum of $150,000 per charger
Hydrogen refuelling station	Dispensing at 350 bar minimum for medium- and heavy-duty vehicles and 700 bar minimum for light-duty vehicles	Up to 50% of total project costs, to a maximum of $1,000,000 per site	Up to 75% of total project costs, to a maximum of $1,500,000 per site

[11] For Level 2 chargers, each connector can count as a unit towards the minimum of 20 chargers if each connector can charge a vehicle at the same time.

All direct expenses such as salary and benefits, professional services, capital equipment expenses, rental fees or leasing costs, licence fees and permits, environmental assessment costs, and up to 15 per cent of overhead expenses are **eligible for funding** from this program.

Most notably, in-kind costs, land costs and ongoing operating costs such as electricity consumption, operation, maintenance, networking fees and subscription fees are **not eligible** for funding.